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ORIGINAL ARTICLES

MUTILATED CASES OF MALOCCLUSION*

BY ADELBERT FERNALD, D.M.D., BOSTON.

Instructor in Orthodontia in the Dental School of Harvard University.

IT would be very nice if one could select those cases for treatment which have all the teeth present, the patient the proper age, and where normal occlusion could be established.

I am not going to tell about or show you normal occlusion, but will leave that for those who may choose ideal cases, in which perfect results may be secured; although I have under treatment many cases where all teeth are present, and it will be my fault if I do not get perfect results.

I wish to show a few of those unfortunate cases where mouths have been mutilated by loss of teeth and improper fillings and normal occlusion can not be obtained. I know that many will say if one or more teeth are lost, restore the remaining teeth to normal and supply the missing teeth; in some cases I would do that too, but I wish to speak about those cases where the patient has little time and less money, whose age is unfavorable, and many who are sick from inability to masticate their food. What shall we do? Tell them that they are too old, or that it will be very expensive, discourage and send them away to grow more hideous and unhappy? I will admit a man can not do charity work all the time, but there are many such cases where the occlusion can be made more efficient and the appearance of the mouth improved.

In treating any case of malocclusion, it makes a great difference if the condition is acquired, or congenital. Consider a case of Class III (mesioclusion) with one or both superior laterals missing. After treatment, it may be necessary to supply them. But in many mutilated cases I have found that by extracting one or more teeth to equalize the sets, the occlusion could be made more efficient and the patient would not be compelled to wear an artificial tooth through life, or be under treatment long.

*Read before the Harvard Odontological Society, Nov. 16, 1916.

There have been many cases at the Harvard Dental School where the four broken-down first molars have been extracted, and the second molars brought forward so that the wisdom teeth could erupt in place of the second molars. I will not say perfect, but good results have been obtained.

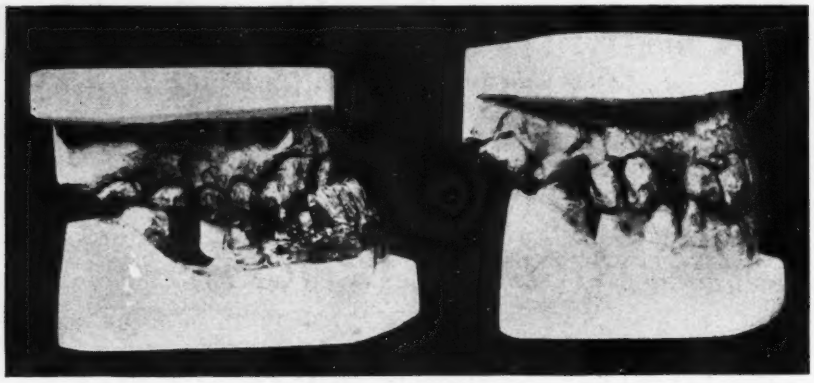


Fig. 1.—Case I.

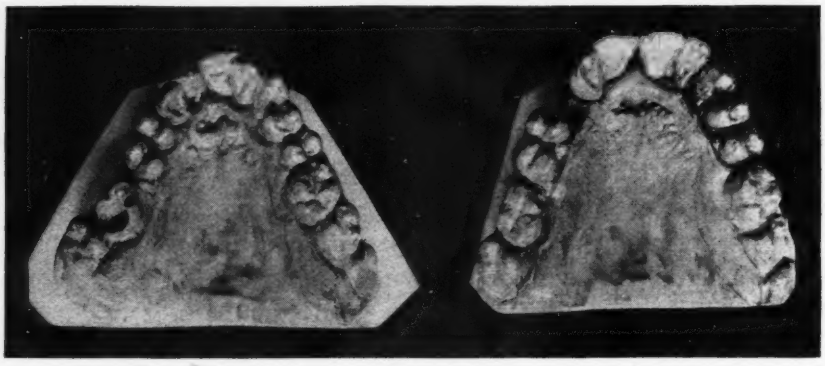


Fig. 2.—Case I.

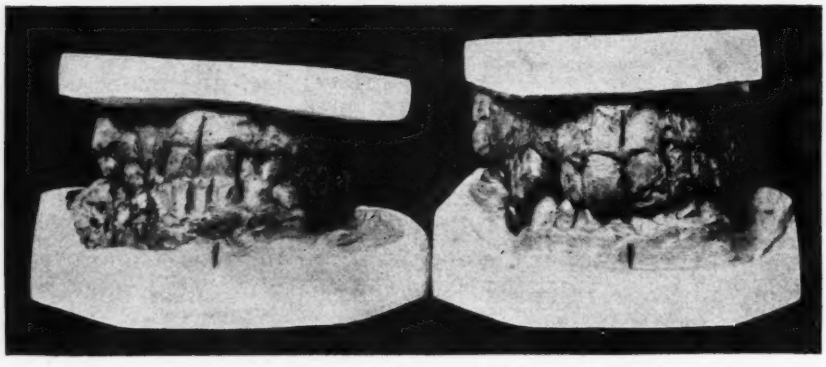


Fig. 3.—Case I.

One should use great care in deciding which tooth or teeth to extract in treating such cases, and I will show you some cases where I think someone made a great mistake in taking out any teeth at all, also cases where I have taken out premolars or canines and I will let you be judge and jury of the results.

As we get new bone growth at all ages and the tissue and cells of the body are being renewed all the time, there are few mutilated cases that could not be helped. I will show you one case, patient thirty-three years old, Class III, that I treated when I first graduated and have watched for twenty years.

I would like to report one case, which to me is unusual. A little girl three and a half years old was brought in to have her teeth regulated, a case of Class II, complete distal occlusion, a mouth breather and extremely nervous, with adenoids and enlarged tonsils. I requested the parents to have the adenoids and tonsils removed, which was done, and then to wait until the child was a little older and stronger, before having the teeth straightened. I told the little patient to keep her mouth closed at night so that spiders would not crawl in. She would retire with mouth closed tight and her hand over her lips. After the operation she became much stronger, and on seeing her a little over a year later, I was amazed to find that the lower jaw had come forward into normal occlusion, and it has remained so.

CASE I.

Fig. 1 represents the case of mesioclusion (Class III) that I referred to as being treated over twenty years ago. The patient was a man thirty-three years old. The inferior right second premolar, and first, second, and third molars had been extracted,—also the superior right canine and six year molar.

This being one of the first cases I corrected after graduating, I shellacked the models with several coats of yellow shellac, which is the cause of the peculiar appearance of the photo.

The inferior six anterior teeth had been pushed forward by the force of the occlusion, and I think in this case, the whole mandible to some extent. After the superior right cuspid had been extracted, the superior centrals had been forced back, the cuspid space was entirely closed. The superior median line was nearly one-fourth of an inch too far to the right (Fig. 3, left) the arch being very narrow. The bands were adjusted on the superior twelve year molars, the centrals and laterals carried forward, restoring the canine space.

The teeth moved very slowly, requiring so much force to move them at all, that I resorted to the jack-screw, adjusting it to the bands attached to the premolars with arms running back to the molars. The patient was given a wrench, and in eight months the premolars and molars were expanded nearly a quarter of an inch (Fig. 2). The canine space was restored by bridge-work, and a retainer consisting of a gold wire attached to bands fastened to right and left first biscupids,—also right and left first molars.

After restoring the canine space by the bridge, the patient, as well as myself, was delighted to find that the median line between the two centrals came in the center of the face, which greatly improved the personal appearance of the face and mouth (Fig. 3, right).

The inferior third molar and right and left premolars were banded to reinforce the anchorage while drawing the anterior teeth distally, which I did by stretching elastic bands from hooks on one premolar round to the other,—the patient adjusting the bands as needed. Remember this case was treated

over twenty years ago, it being the first of its kind that I had ever treated, and I resorted to methods which today might be questioned.

After anterior teeth had been drawn distally, and the bite had "jumped," a twenty gauge wire was adjusted in the hooks in place of rubber bands. A partial gold plate was made supplying the missing teeth. Fig. 3 shows the case before the missing teeth had been supplied.

I have watched this case for over twenty years, and you may ask, "Did the teeth stay in place?" I will tell you frankly they did not, but gradually

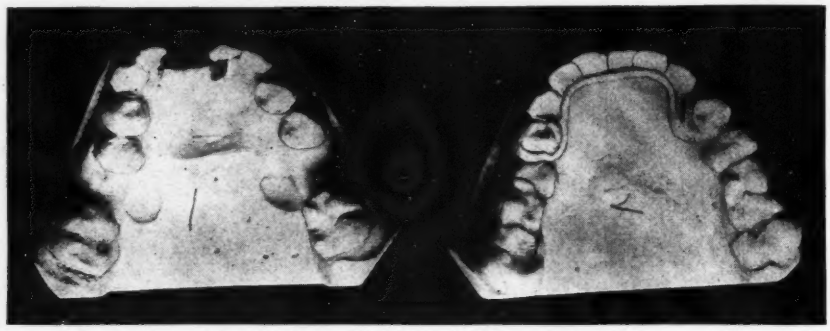


Fig. 4.—Case II.

changed to an end-to-end bite, and have remained in that position. The median line, however, is still in the center and the general effect is good, and the patient has an efficient occlusion. This case took over two years to correct.

CASE II.

A young girl, eighteen years of age, presented a mutilated case of Class I (Figs. 4 and 5).

Fig. 5.—Case II.

The dentist who had charge of this case since the patient was a child, told her he would straighten her teeth when she became older. (This is the patient's statement.) When she became eighteen, the inferior first molars were removed as well as the superiors, with the right premolar. Then as the teeth did not straighten themselves, the patient was told she was too old to have anything done.

I expanded the inferior teeth and bridged in the missing molars, with the

results shown in Fig. 4. While expanding the superior arch, I was able to pull the second molars forward, and close up the space occupied by the first molars. In Fig. 5 the case is shown partially completed; the model of the completed case was destroyed by an accident. A case mutilated like this is much harder to treat than if all the teeth were present, it being a great mistake to extract any tooth in this type of case. The superior wisdom teeth have erupted, holding the second molars forward very nicely.

CASE III.

Case 3 is a young man, nineteen years old, showing a Class I case (Figs. 6 and 7).

Fig. 6.—Case III.

The superior right canine had erupted outside of the arch, the labial surface was decayed from the gingival to the incisal edge, and was extremely sensitive, and the molars and premolars were improperly filled.

The patient was working at a small salary, and the only time he could come to my office was during his noon hour. In this case I advised the removal of the canine. The third molar erupting, closed the space completely,

Fig. 7.—Case III.

no appliance being placed on the superior teeth. The inferior left second premolar was badly broken down and had an abscess on the root, consequently that tooth was also extracted. The inferior left canine and first premolar were forced back, and the space closed, allowing room for the centrals and laterals to be brought into position. The canines were banded, and an eighteen gauge wire was soldered to the lingual side of the bands, which has retained the teeth in position. Figs. 6 and 7 show the results.

It seems to me that under the conditions, I did the only practical thing, although I dislike to extract a tooth.

CASE IV.

Case 4 is interesting to me in this way,—the patient was a little girl, ten years of age, and had never been to a dental office before. The first molars were practically all gone, and there were eighteen deciduous teeth, and the roots of the first molars present. They were all removed, but not at one time. (Figs. 8 and 8*A*.)

Fig. 8.—Case IV.

Fig. 8*A*.—Case IV.

This was a charity case and no appliance was adjusted. The patient was instructed to press forward on inferior laterals with her tongue. Fig. 9 shows the results one year later.

This case illustrates very well how teeth may become irregular by keeping the decidous teeth too long, as the permanent teeth, erupting at the line of least resistance, will be deviated by them. Fig. 8*A*, illustrating the superior

Fig. 9.—Case IV.

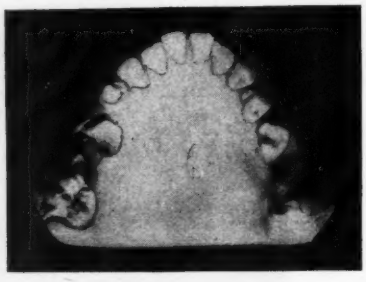


Fig. 9*A*.—Case IV.

teeth, shows this very nicely. The deciduous lateral being retained, the permanent lateral erupted inside the arch.

The last time I saw this patient, which was about three years after the extraction she had a very efficient occlusion (Figs. 9 and 9*A*).

CASE V.

Figs. 10, 10*A*, 11, and 11*A* illustrate the case of a young man nineteen years of age with a mutilated case of Class II (distoclusion). He was work-

ing his way through college, and had very little time to devote to the care of his teeth.

When I saw the case it was badly mutilated, with the loss of the inferior first molars, the second molars badly broken down, and the left premolar was erupting outside of the arch just under the mucous membrane (Fig. 10*A*, left). The inferior right second premolar erupted inside the arch. The superior

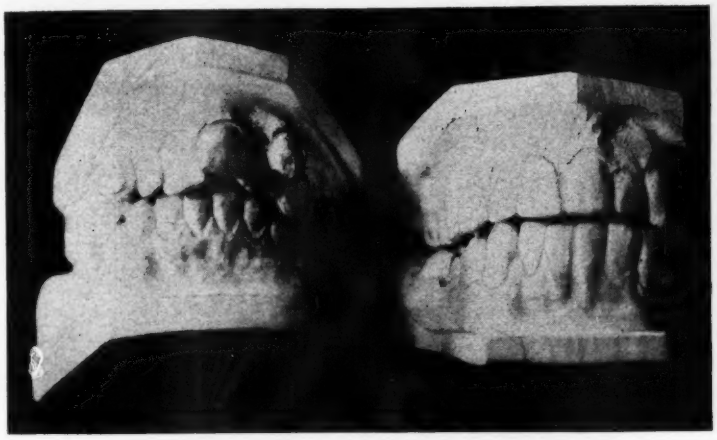


Fig. 10.—Case V.

first molars were banded, expanding the canines and premolars, and the centrals were brought into position. The inferior second molars were banded and the six anterior teeth were brought forward, and a space for the inferior left first premolar was opened up.

By the time the space was wide enough, the first premolar on the left had erupted into position. The second premolar on the right was brought into

Fig. 10*A*.—Case V.

line, and intermaxillary elastics were adjusted. The second molars were brought forward to close up the space where the first molars had been extracted (Fig. 10*A*, right).

About this time the third molars began to appear. They came forward in line of least resistance, and held the second molars from dropping back.

The appearance of the mouth at this period is shown in Fig. 11. The use of intermaxillary elastics was continued until the case was completed, as seen in right of Fig. 10.

While it is impossible to get perfect occlusion in these mutilated cases, I know that I have improved the occlusion and the appearance of this mouth.

CASE VI.

This patient was a girl, thirteen years old, presenting a Class III (mesio-clusion) case complicated by the failure of the upper laterals to develop (Fig. 12). This case is shown to illustrate a method of bodily moving the teeth with the ribbon arch.

Fig. 11.—Case V.

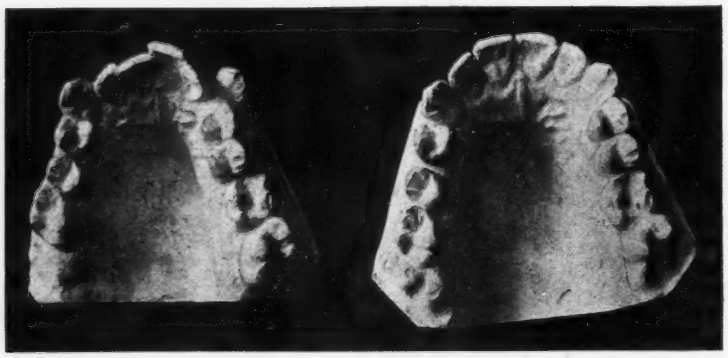


Fig. 11*A*.—Case V.

The first molars were banded, and the ribbon arch adjusted, the anterior part of the arch being made of twenty-four gauge clasp metal, so there would be no lateral movement when the ribbon arch was adjusted into a three-sided box soldered to the labial surface of bands on the centrals. (The arch I used in this case is shown at the bottom of Fig. 12.) In this case, the canines erupted beside the centrals, an x-ray showing no laterals present. The arch was expanded and the two centrals were carried bodily forward by tightening the nuts of the ribbon arch.

I have used this method for fifteen years, and have found it very efficient to move the apices of the teeth forward. After the centrals were carried for-

ward into position (Fig. 12), two laterals were bridged into place with the lingual wire running back, spreading the arch. Then intermaxillary elastics were adjusted to bring the superior arch forward, and the inferior arch backward into normal occlusion. This case was treated in 1909.

CASE VII.

A girl, seventeen years old whose teeth were improperly filled, presented a Class II case as shown in Fig. 13.

The superior first molars were banded, the wire adjusted, and the cuspids and premolars on each side expanded to obtain room to bring the superior left

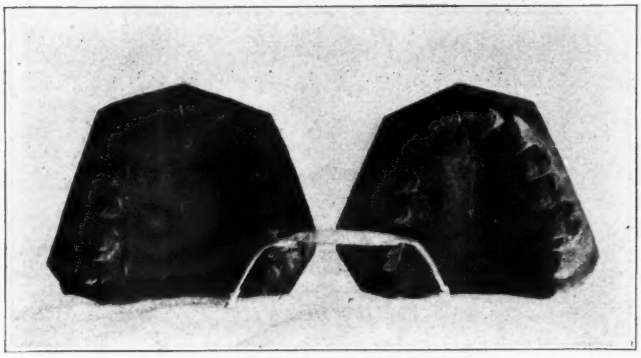


Fig. 12.—Case VI.

Fig. 13.—Case VII.

Fig. 14.—Case VII.

lateral forward into line. The inferior first molars were banded, and six anterior teeth were brought forward. Then intermaxillary elastics were adjusted and good occlusion obtained. The lower third of the superior centrals was missing, so they were crowned (Fig. 14). Occlusion has been made efficient, although not perfect, and the appearance of the mouth is greatly improved.

CASE VIII.

A man, twenty years old, Class III (mesioclusion). The superior right second premolar was missing, and the deciduous molar was firmly in place. The inferior molars and premolars were improperly filled. (Figs. 15 and 16.)

This man was also working his way through college, and had very little time from his studies to give to the care of his teeth.

All of the four first molars were banded and arches adjusted, but movement was extremely slow, and his time so limited, that as a *last resort,* the inferior right and left first premolars were extracted (Fig. 16). Then the whole force of the intermaxillary elastics was put on the six anterior teeth, and they immediately began to move back until the canines were in contact with the

Fig. 15.—Case VIII.

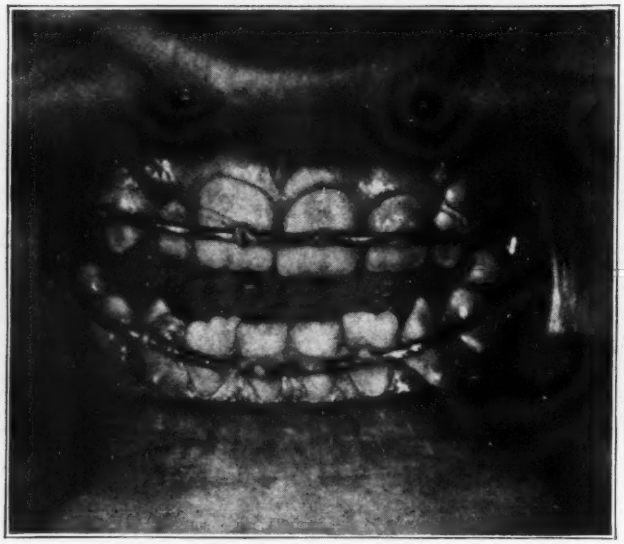


Fig. 16.—Case VIII.

second premolars, completely closing up the space occupied by the first premolars. While this was taking place, the superior anterior teeth were moving forward, and the bite jumped (Fig. 17). The appearance of the mouth has been greatly improved, and the profile is nearly normal (Fig. 18).

In retaining this case, the superior right and left cuspids, and first molars were banded, and lingual wire soldered to the four bands, with hooks on the buccal surfaces of the molars, so that the rubber bands could be adjusted to

hooks on the labial surface of inferior right and left canine bands. The right and left inferior molars and canines were banded, and a wire soldered to the buccal surfaces, running round the labial surface of anterior teeth as shown in Fig. 16.

Fig. 17.—Case VIII.

Fig. 18.—Case VIII.

So far the case has been very easy to retain, and I am satisfied that under the circumstances, I did the only thing practical. I dislike to extract teeth in such cases, but where patients have not the time, and the age is unfavorable, the appearance and efficiency of the occlusion in most cases can be greatly improved.

TECHNOLOGY IN ORTHODONTIA*

By Gilbert Dudley Fish, C.E., New York City.

THE influence of technology on orthodontia demands your attention. Engineering methods, applied in the diagnosis and the treatment of malocclusion, are producing results which mark the passing of empiricism in orthodontia. Where an art has stood, there is growing up a science.

It is true that the underlying causes of deformities of the dental arch are yet obscure. There can be no doubt, that any light which may be thrown upon the origin of these developmental aberrations must come through biological research. We are agreed, that the behavior of living tissue under specified treatment can not be exactly determined in advance.

Yet it must be admitted, that the only known means of correcting deformities of the dental arch, are fundamentally mechanical. It is axiomatic, that teeth, the surrounding tissues, and any appliance attached to the teeth, are all governed in common by the immutable laws of the exact physical sciences. It can be demonstrated, that the analytical problems in mathematics, physics, and animal mechanics, underlying the orthopedic treatment of malocclusion, can not be rationally handled, or even intelligently studied, by men unversed in technology. Wherefore I urge you to consider well the question of informing yourselves as to the rudiments of mechanics. Provide the students in your schools of orthodontia with instruction in the subject.

I admit, that it will not be easy to give the dentist, trained in subjects far removed from technology, a grasp of the fundamentals of kinematics and dynamics; but I insist, that the necessity has arisen and must be faced.

There can be no doubt, that the awakening of the public to the meaning of orthodontia, will give rise to a world-wide demand for early treatment of children. It is not visionary to believe, that orthodontia is destined to be the beginning and the end of the dentistry of the future. You, as specialists, have the advancement of this subject in your hands. I wish to plant in your minds the idea, that another science, older than your own and further developed, holds a great store of information which you require for your further progress.

It is my purpose today to illustrate a few applications of mathematical science in orthodontia, not with the idea of offering instruction in mechanics and allied subjects, but in order to suggest to you that technology is a vast field, offering limitless opportunity for research.

Mechanics is not the trade of an artisan; it is a major division of physics. Mechanics bears about the same relation to the shop-work of the so-called "mechanic," as engineering bears to the work of the locomotive engineer.

The partition of mechanics into natural divisions, is illustrated schematically by Fig. 1. Kinematics is the science of motion, considered without reference to the forces involved. Dynamics is the science of force and other circumstances of motion. Kinetics is that part of dynamics dealing with variable

*Read before the Alumni Society of the Dewey School of Orthodontia, Chicago, Ill., March 14, 1917.

motion. Statics is that part dealing with uniform motion, including the special case known as "rest."

The problem of predetermining the occlusal arch falls naturally into the department of kinematics, which is the calculus of motion. Motion, kinematically speaking, is purely relative, and consists in change of position of two or more bodies with respect to one another. Motion at any instant is measured by velocity, the magnitude of which is the time rate of change of position. In the case of motion of translation, which is bodily displacement independent of rotation, the line of action of the velocity defines at any instant the line along which the motion of translation is occurring. In the case of motion of rotation, which consists in turning about an axis independently of translation, the axis to which the angular velocity is referred is the axis of rotation.

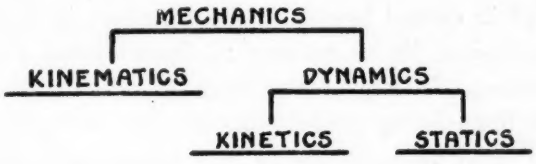


Fig. 1.

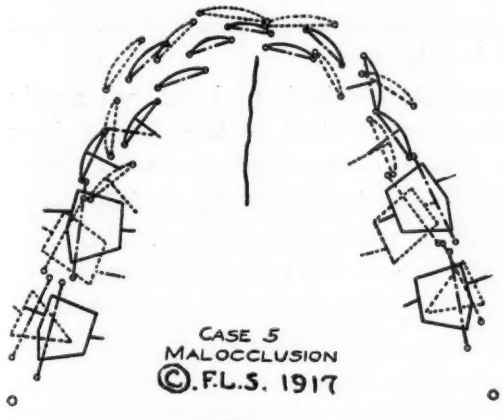


Fig. 2.

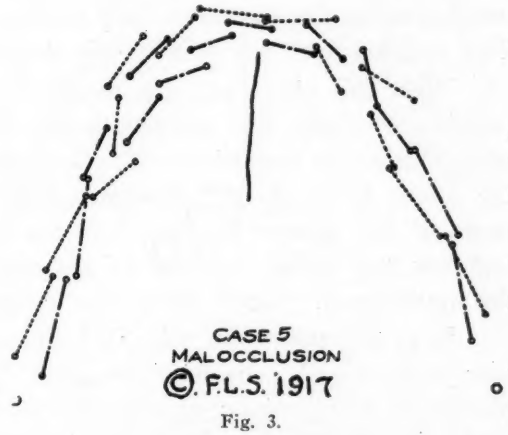


Fig. 3.

In describing the motion of a body, it is necessary to specify to what other body the motion is referred, unless the same is tacitly understood. When a train approaches Chicago, is it not true that Chicago approaches the train? It is convenient to consider Chicago stationary and the train in motion, because Chicago is a fixed part of the earth, which is the natural ultimate reference body for motions incidental to terrestrial affairs. When a soldier is hit by a bullet, the impact is mutual, though the effects may be one-sided. If it is said, that both soldier and bullet are in motion at the instant of meeting, but that the bullet is moving the faster, it must be inferred that the motions are referred to the earth, otherwise there can be no significance in the remark.

A man walks down the aisle of a train, conversing. His mandible is in motion. What is meant by this observation? That his mandible as part of the solar system, is traveling through interplanetary space at so many miles per second? That it shares the orbital and axial motions of the earth? That

it is approaching Chicago at a mile a minute, or nearing the rear of the train at four feet per second? Or does it mean that, as an attachment of the head it is nodding and swaying as the head nods and sways? No. All of the above circumstances exist in fact simultaneously, but not one of them is inferred by the remark that the jaw is in motion. It is only the motion mutually existing between jaw and skull that is considered.

Arch predetermination is a kinematic problem. The solution embraces the prediction of the relative positions of the teeth when placed in occlusion according to the specifications governing occlusion. The solution does not include the determination of the movements of the teeth in reference to the skull, but shows only the displacements and rotations of the teeth in relation to one another. Let me illustrate:

Fig. 2 shows an orthographic projection of a denture in malocclusion. The superiors appear in dotted lines and the inferiors in solid lines. To make the diagram less confusing, let us remove all lines except those joining the approximal contact points. In Fig. 3 the teeth in malocclusion are depicted by straight lines, these lines being projections of the mesio-distal diameter lines.

Let us suppose, that by solution of the kinematic problem of arch predetermination for this case, we ascertain the form and dimensions of the occlusal arch. This involves, among numerous other requirements, the joining end-to-end of the diameter lines for the upper denture and also for the lower. The occlusal arch for this case is shown in Fig. 4.

With this chart and the maps of malocclusion both at hand, we are in position to study the relative tooth movements involved in the change from malocclusion to occlusion. To facilitate this, we superimpose one map over the other, so as to see, simultaneously, the malocclusal and the occlusal positions of the teeth. In Fig. 5 is shown, as a result of bringing these maps together, the change in form of the upper arch and the relative movements of the upper teeth. Fig. 6 shows the corresponding changes in the lower denture.

If at this point you ask, "Why place the maps of occlusion *in that particular position* with respect to the maps of malocclusion?" I reply that any other placement would show exactly the same movements of all teeth, upper and lower, in relation to one another, and that the relation of arches here shown is merely my estimate of the placements which reveal most *simply and clearly* the tooth movements.

Figs. 7 and 8 are the same as Figs. 5 and 6, respectively, except for the restoration of the conventional tooth forms. Fig. 9 shows the arch of occlusion with tooth forms represented in the same way.

The significance of the relativity of motion in this problem of plotting tooth movements, is that we are not dependent upon so-called "fixed points" from which to measure. It is not necessary that we know in advance the ultimate location of the occlusal arch in relation to the skull, for in the treatment of malocclusion we are confined to the teeth themselves for anchorage. In fact, precise advance information in regard to the resistance of the alveolar process to movement of the teeth would not provide us with any means for moving the dental apparatus bodily in its foundations, if we limited ourselves to appliances contained wholly within the mouth.

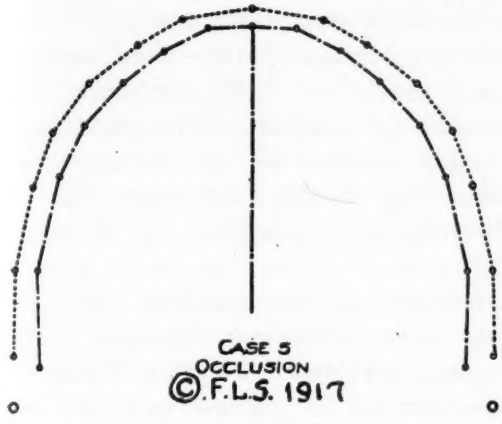


Fig. 4.

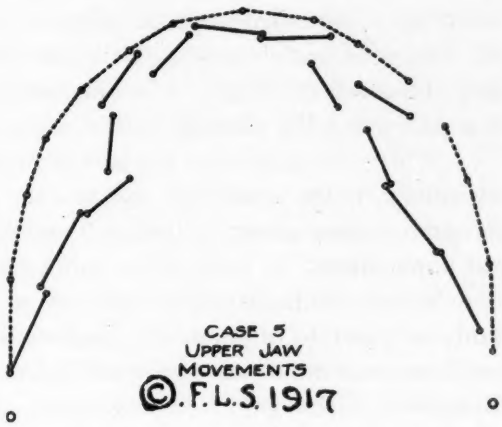


Fig. 5.

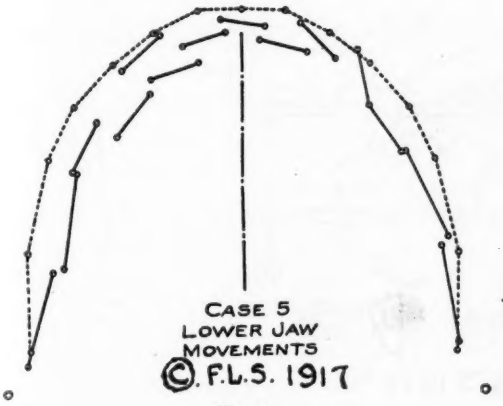


Fig. 6.

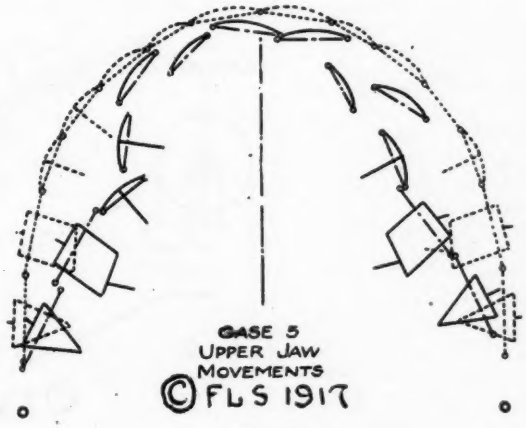


Fig. 7.

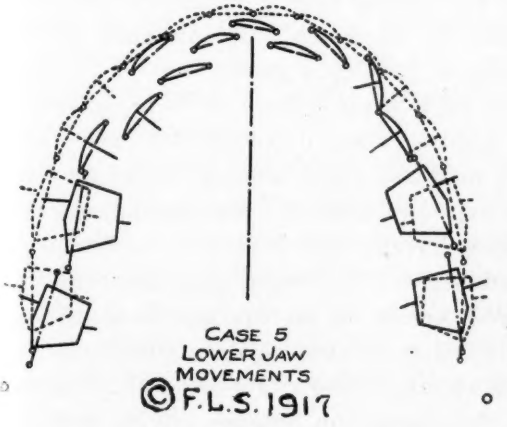


Fig. 8.

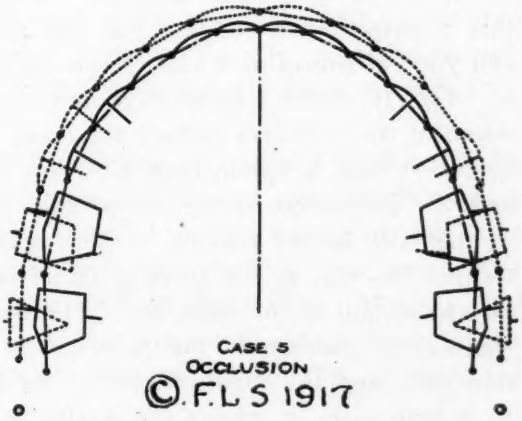


Fig. 9.

For divers reasons it would be highly advantageous to have means of studying tooth movement in relation to the skull. An instrument which will fill this need and others as well, the *projecting craniograph,* has been invented and designed in detail. Circumstances, too painful to dwell upon, have thus far prevented the placing of the order for the construction of this instrument.

When we approach the subject of appliances for moving teeth, we find ourselves in the realm of dynamics. According to the fundamental laws of dynamics, announced by Isaac Newton, the following principles are of universal application:

Every action of force sets up an equal and opposite reaction; and every body or particle of matter is possessed of inertia, whereby it maintains rest or uniform motion when not acted upon by any unbalanced force; and whereby it suffers a change of motion upon application of an unbalanced force, said change of motion, otherwise called *acceleration,* taking place in the direction of the force, at a rate directly proportional to the magnitude of the force, and inversely proportional to the mass of the body.

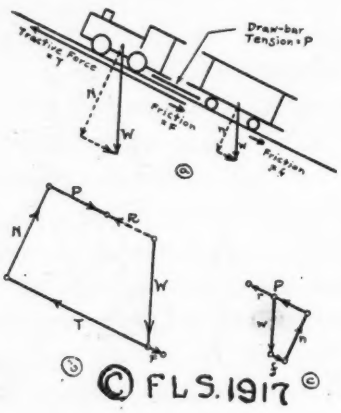


Fig. 10.

When an appliance presses against a tooth, the tooth presses back against the appliance with equal intensity. Lest you should find it difficult to reconcile this principle with the fact that the tooth moves under this influence, let me call your attention to a locomotive starting a train up a grade.

Fig. 10 shows a locomotive and a car on a steep slope. If there is enough steam in the cylinders to hold the train against rolling downhill, but just insufficient to start it uphill, then the train is in equilibrium, and all forces are balanced. The forces acting on the engine are its weight *W;* the normal reaction of the rails *N;* the friction of rails against drivers, which friction is the longitudinal reaction to the tractive effort induced by the steam pressure; and the backward pull of the draw-bar. The forces acting on the car are its weight *w;* the normal reaction of the rails *n;* the friction of rails against wheels, acting downhill; and the forward pull of the draw-bar. The draw-bar pull, referred to in both cases, is simply the tension in the connection between engine and car. If now the steam pressure be raised, the tractive effort will increase, and there will be a corresponding jump of the draw-bar pull. This force will be in excess of the forces tending to hold back the car, and motion up-hill will com-

mence. The rate of acceleration will be in direct proportion to the unbalanced pull in the bar, and inversely proportional to the inertia of the car. At every instant, the car pulls back on the engine exactly as hard as the engine pulls on the car, by the laws of action and reaction; the car moves, because this pull exceeds the other external forces holding back on the car. The difference is manifested by the acceleration imparted to the car.

The same principle applied to the case of the appliance pressing against the tooth, shows that the question whether the tooth moves against the resistance of the medium in which it is embedded is decided by whether the active force applied to the tooth exceeds the resistance developed by the alveolar process—not by whether the active force exceeds the reaction of the tooth, for that could never happen. The infinitesimal difference between the active force and the resistance of the foundation is responsible for any tooth movement which takes place.

Bodies at rest are in equilibrium; i.e., are not acted upon by any unbalanced force or couple. An explanation of the term "couple," and a statement of the conditions of equilibrium, will be given later.

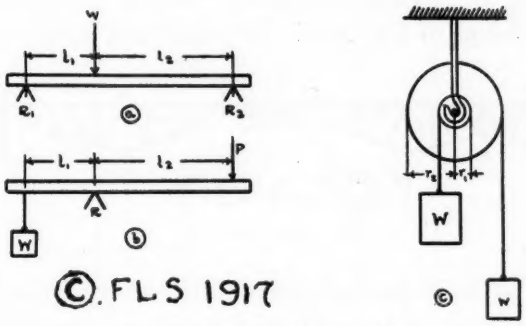


Fig. 11.

Inasmuch as the relative motions of the parts of an appliance attached to the teeth are exceedingly slow, the appliance may be considered in equilibrium. This principle is a valuable one in appliance design, because it enables the designer to apply the laws of equilibrium and so analyze the reactions between appliance and teeth. In fact, because the appliance may be regarded as stationary, the analysis of the forces involved falls under the head of *statics* instead of *kinetics.*

In order to understand the laws of *equilibrium,* or *balance of forces,* it is necessary to know the meanings of the words *couple* and *moment* as used in mechanics. A couple is simply a pair of parallel forces, acting on the same body, equal in magnitude but opposite in direction, which do not meet. The tendency of a couple is to induce *rotation without translation.* The measure of magnitude of a couple is the product of the amount of either force, multiplied by the distance between their parallel lines of action; this is called the *moment* of the couple.

Any completely known system of forces, acting upon a rigid body, may be considered replaced by a single force and a single couple, as far as the motion of the body is concerned. This force and this couple may be determined by a

routine process. If force and couple both prove to be nil, then evidently there is no *resultant* force to accelerate the body in translation, and no resultant couple to impart angular acceleration. In this special condition, the body is in equilibrium, whether it be in motion or at rest.

Fig. 11 contains three figures illustrative of the principle of moments, otherwise called the *law of the lever.* A beam simply supported at the ends, carrying a weight at an intermediate point, is represented by *a.* By the principle of moments, the system being in equilibrium, the left reaction R_1, which must act vertically upwards, is equal to the weight W multiplied by the distance l_2 and divided by the span l_1+l_2; similarly R_2 is $W \times \frac{l_1}{l_1+l_2}$; the sum of R_1 and R_2 equals W. A cantilever beam, or lever of the first class, is shown at *b.* If P is an active force and R the reaction of the fulcrum, then, whether the lever is in equilibrium or rotating about the fulcrum, the action of P is transmitted by the lever to the cord holding the weight W, and induces in the cord a tension equal to $P \times \frac{l_2}{l_1}$; if the tension equals the weight W, then P and W balance each other; if the tension exceeds W, the weight is raised; if W exceeds the tension, the weight descends; in any case, the fulcrum reaction equals P plus the tension in the cord. A wheel and axle combination is shown

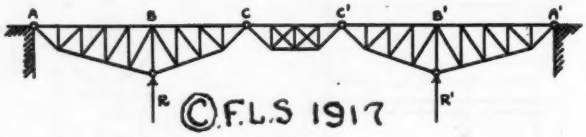


Fig. 12.

at *c.* If the system is to be in equilibrium, the ratio of the large weight to the small one must be the same as the ratio of the radii of the wheels, $r_2 : r_2$.

When an appliance attached to two or more teeth presses against or pulls on them by virtue of its elastic deformation, the teeth react against the appliance; these reactions are exactly equal and opposite to the forces exerted by the appliance against the teeth. If the material, sectional dimensions and form of an elastic wire appliance be known, and also its elastic deformations when in place, and in addition the exact nature of each attachment or connection to band or crown, then it is possible to calculate the direction and magnitude of every reaction between tooth and appliance. The information above listed is available, if the number and arrangement of attachments be properly restricted, if the nature of the attachments be made to conform to certain requirements, and if the metal be not deformed beyond its elastic limit. While the above mentioned conditions are not realized in the appliances commonly met, it is possible to design appliances conformable to them.

Two considerations are held uppermost in designing an appliance, by engineering methods, to carry out predetermined tooth movements. One consideration, which is obvious, is that the appliance shall be structurally suitable for imparting to the teeth their required displacements. The other, which is *new thought,* is that the connections and the provisions for applying force shall be of such a nature that the internal stresses and the external forces of the

appliance can be calculated and shall be subject to complete and accurate control.

A device frequently employed in civil engineering is the hinge; its function is to serve as a connection without transmitting any bending stress. No force acts upon or is transmitted by a hinge, except direct thrust and direct pull. Inasmuch as the hinge has been made to serve the same purposes in orthodontic appliances as in engineering structures, illustrations of its application in both subjects will be given.

Fig. 12 represents a cantilever bridge. *AB* and *A'B'* are the shore arms; *BC* and *B'C'* are the cantilever arms; *CC'* is the suspended span. *A* and *A'* are the abutments, hinge connected; *C* and *C'* are the hinge connections supporting the truss *CC'*; *R* and *R'* are the supporting hinges on the piers. Hinges *C* and *C'* are structurally advantageous for reasons too technical to be explained here. It is interesting to observe, that if the structure were rigid instead of hinged at these points, the weight of a train on the shore arm *AB* would be felt as far away as the opposite shore at *A'*; as it is, no load between *A* and *C* can cause stress in any part of the bridge between *C* and *A'*.

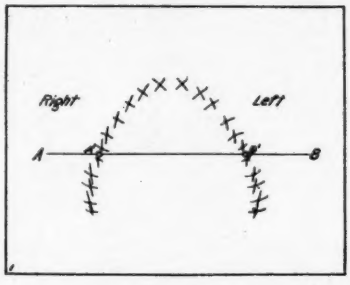


Fig. 13.

The most prominent feature of the hinges in this structure, is that their use in the design of the bridge makes possible the calculation of the stresses in all members or parts, as well as the values of pier and anchorage reactions, under all conditions of loading. In other words, the hinges not only are a structural advantage, but they permit of economical design on account of the certainty and accuracy in calculation which they make possible.

While hinges used in bridges are horizontal, those used in orthodontic appliances are generally vertical. This is easily understood, when it is considered, that whereas the forces acting on a bridge are verticle, most of the reactions on appliances are horizontal. Vertical hinges allow freedom of horizontal rotation, but prevent all other rotation.

An expanding arch of elastic wire, connected to the other parts of the appliance by vertical hinges at the ends, and touching nothing else but those two hinges, can exert no horizontal force other than direct expansive force along the straight line joining the two hinges. If the other parts of the appliance are two yokes attached to the side teeth, one yoke right and the other left, it is possible, by properly locating the hinges which connect expander and yokes, to control completely the movements of the side teeth. The location of a hinge anterior to the center of resistance of the set of teeth attached to a

yoke, provides for greater movement of the bicuspids or temporary molars than of the posterior teeth. If the hinge be placed at the center of resistance, the side unit moves out without rotation. A posterior location of the hinge means greater movement of the molars than of the teeth anterior to them. Needless to say, a well made vertical hinge effectually prevents tipping of the teeth during expansion.

Time limitation prevents me from multiplying examples of the practical use of hinges in orthodontia, and excludes even brief reference to many other interesting applications of engineering principles to appliance design. Enough has been shown to indicate that it is considered of primary importance to have the action susceptible of accurate calculation, so as to avoid undue pressures and movements in wrong directions. Of course, the possibilities of such appli-

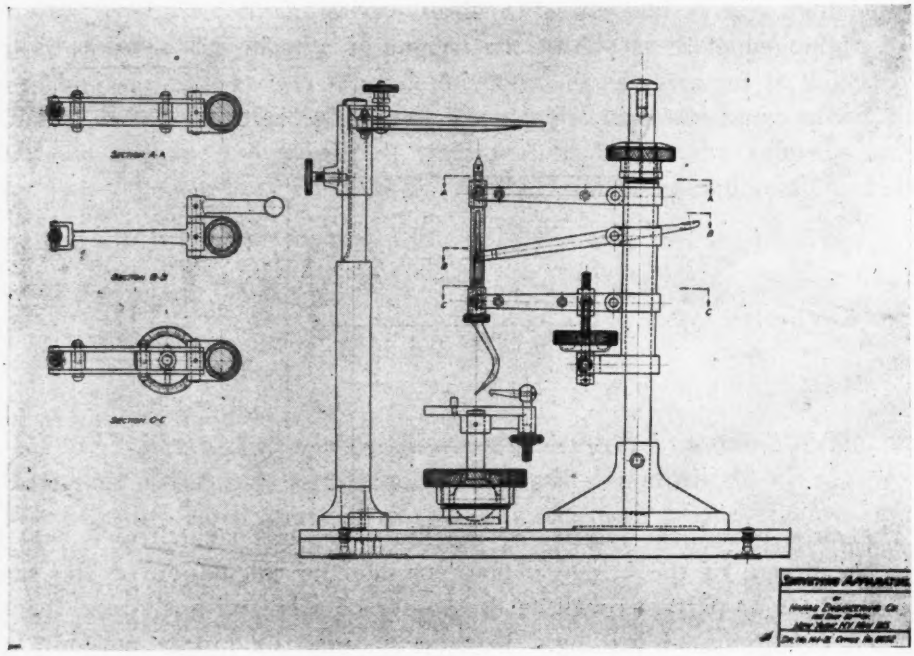


Fig. 14.

ances are not realized unless they are used in connection with accurate maps showing the predetermined tooth movements.

We have so far considered only external forces. Let us look into the internal stresses in elastic wires. The subject of internal stresses and elastic deformations of metal structures is highly mathematical. All internal stresses may be resolved into *direct stress* (tension or compression) and *shear*. Bending stress is a combination of tension and compression; torsive stress is a form of shear.

By Hooke's law, deformation, or strain, is directly proportional to the stress accompanying it, within the limit of elasticity of the material. By the theory of flexure of elastic materials, the condition of stress at any point in an elastically deformed wire of any shape, can be calculated mathematically, provided the deformation be completely described and the material and dimen-

sions of the wire be known. Subject to certain restrictions, the reactions between such a wire and its attachments can be computed. In other words, the directions and amounts of the forces exerted by an appliance against the teeth or other parts to which it is attached, or with which it comes into contact, are susceptible of calculation, provided certain general principles of design be observed.

An interesting application of the theory of elasticity, is an artifice for minimizing the shortening of a wire arch during expansion. The common dif-

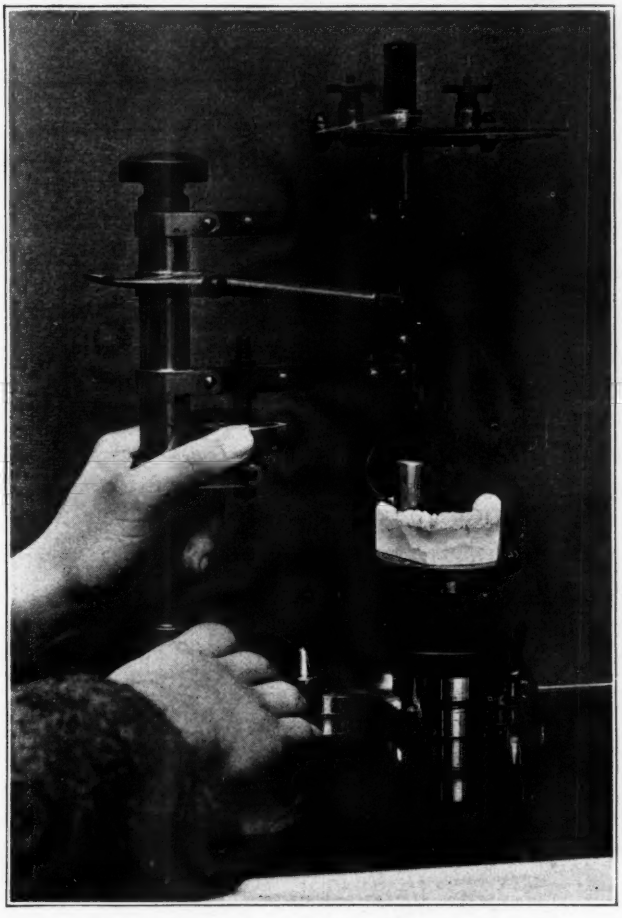


Fig. 15.

ficulty due to the tendency of a buccal wire to press against the front teeth or to bury itself in the gum, may be eliminated by using heavy gauge wire in front and light wire, ending in long flexible extensions, on the sides; the great stiffness of the front as compared with the sides of the arch, causes most of the deformation to occur in the sides. The foregoing is more readily appreciated if it is realized that the deformation of a wire under stress varies inversely as the fourth power of the diameter; i.e., doubling the thickness multiplies the stiffness sixteen-fold.

To present a cursory review of the development of orthodontic surveying, the following series of pictures are illustrative of obsolete and current methods.

Fig. 13 is a reproduction of a map made directly from a model by the use of ordinary dividers. By this method, Frederick L. Stanton was able, in his early investigations, to plot on paper fairly accurate maps of the cases he was studying.

Fig. 14 is a drawing of the dental surveying apparatus designed by Rudolph Hanau according to specifications made by Stanton. This instrument marked a great advance over dividers. It is in use today for making orthographic

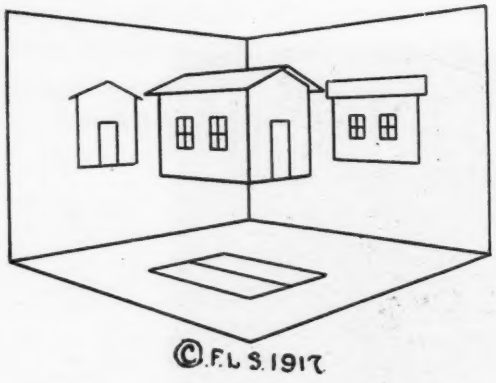


Fig. 16.

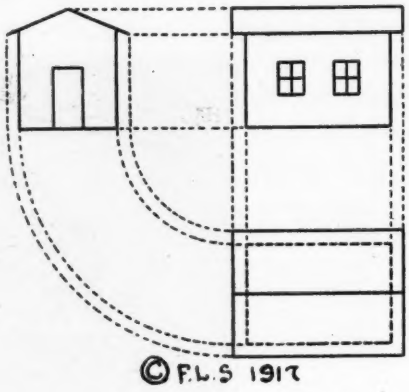


Fig. 17.

projections from models, and for measuring elevations. Fig. 15 is a photograph of this instrument in use.

Figs. 16 and 17 are illustrative of the principle of orthographic projection. All parts of the object are transferred to planes of projection by straight lines at right angles to those planes. This kind of projection reproduces to full scale all dimensions parallel to the projection plane. Photography projects in perspective, which does not, in general, reproduce to scale.

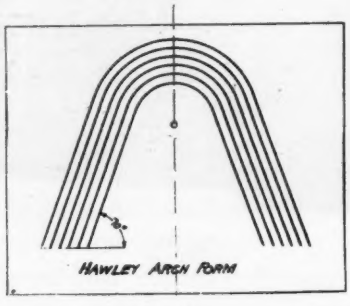


Fig. 18.

To introduce the subject of arch predetermination, I shall make the following general statements. The normal dental arch is individual for every person. The variation in form of arch among the various races is very wide; although the maximum variation in width of arch across the superior first molars is only about 18 per cent, the range in altitude from upper central incisors back to a line across the first molars is in the neighborhood of 50 per cent of the middle value. A given individual's teeth, if susceptible of normal occlusion, can occlude normally on one arch form only; a very slight variation

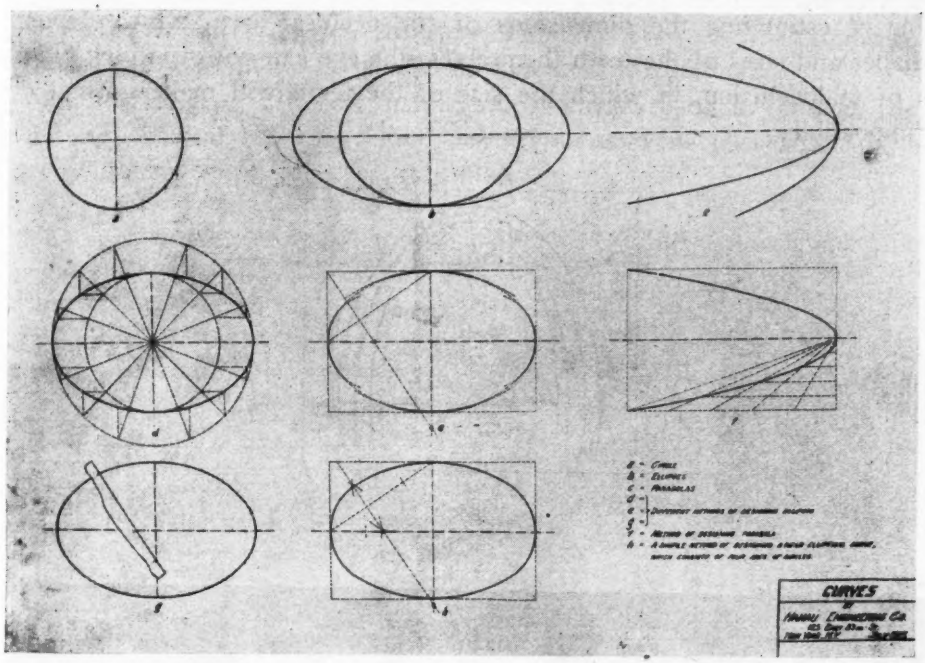


Fig. 19.

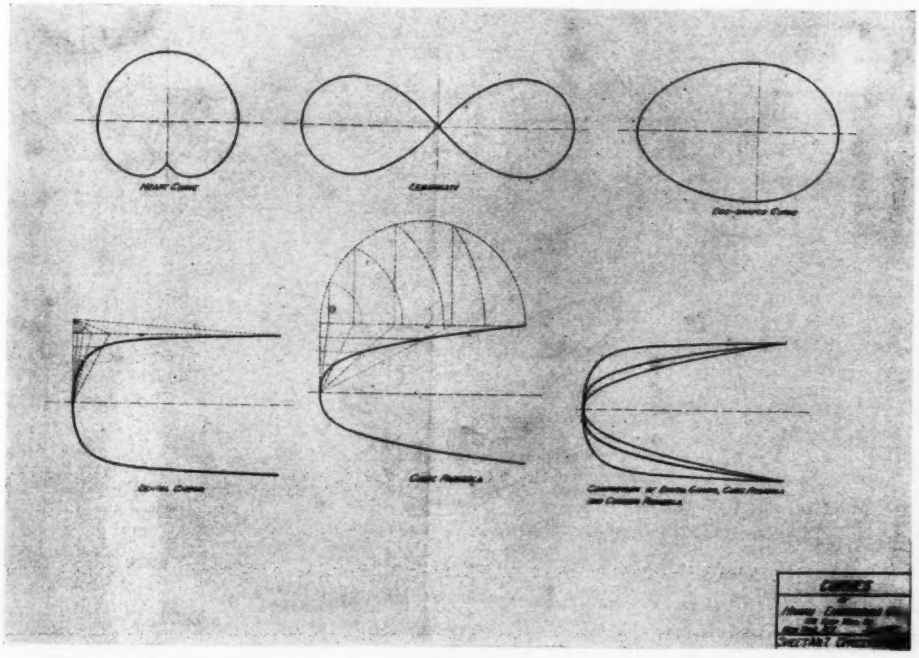


Fig. 20.

in the dimensions of the individual's occlusal arch is permissible, due to flexibility of the conditions or requirements of normality. The human eye is incapable of estimating the dimensions of the occlusal arch, which depend on the shapes and sizes of the teeth themselves; the eye can not even pick out those cases of malocclusion, in which the size of the teeth will make normal occlusion impossible.

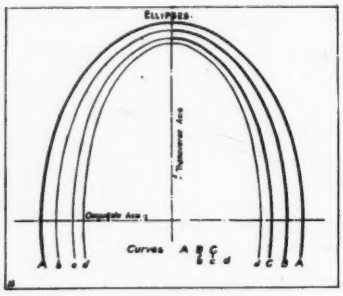


Fig. 21.

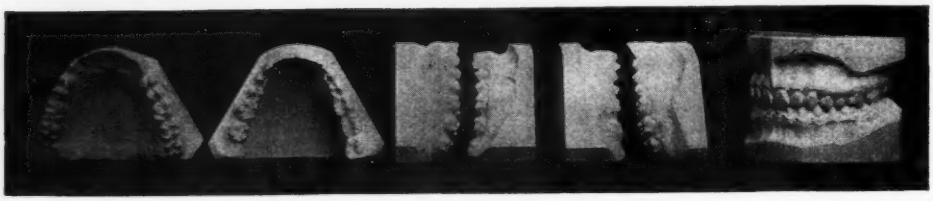


Fig. 22.

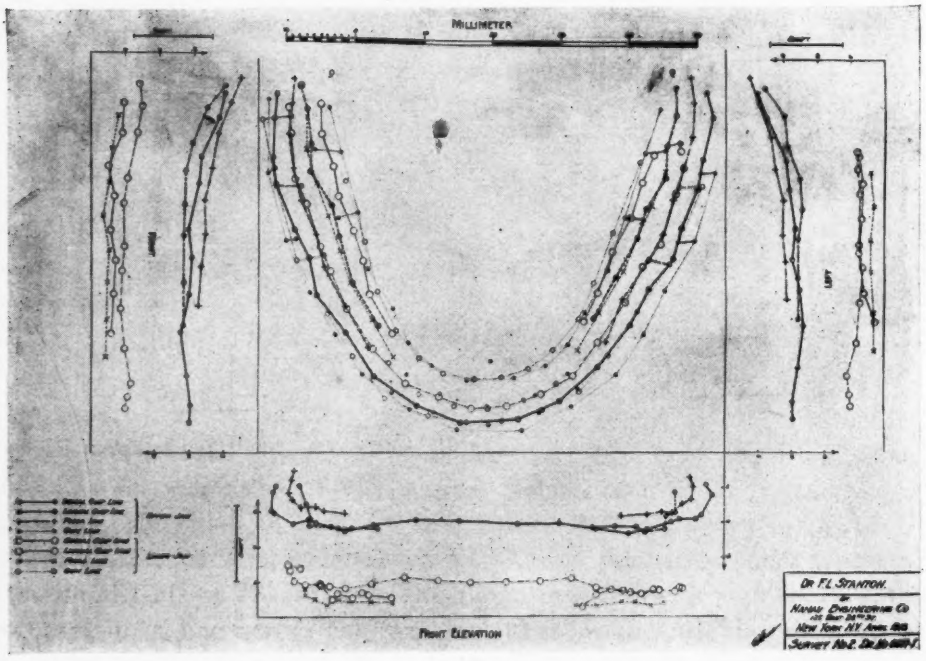


Fig. 23.

Fig. 18 shows a conventional form of arch which for a long while was used by many orthodontists as a pattern. The Hawley arch varied in size, but was always of the same shape. In view of the variety of shapes found in normal skulls, any such guide is seen to be incorrect in principle.

Figs. 19, 20, and 21 show mathematical curves used by Hanau for predetermining occlusal arches. These investigations were profitable and led to the production of some very accurate plans.

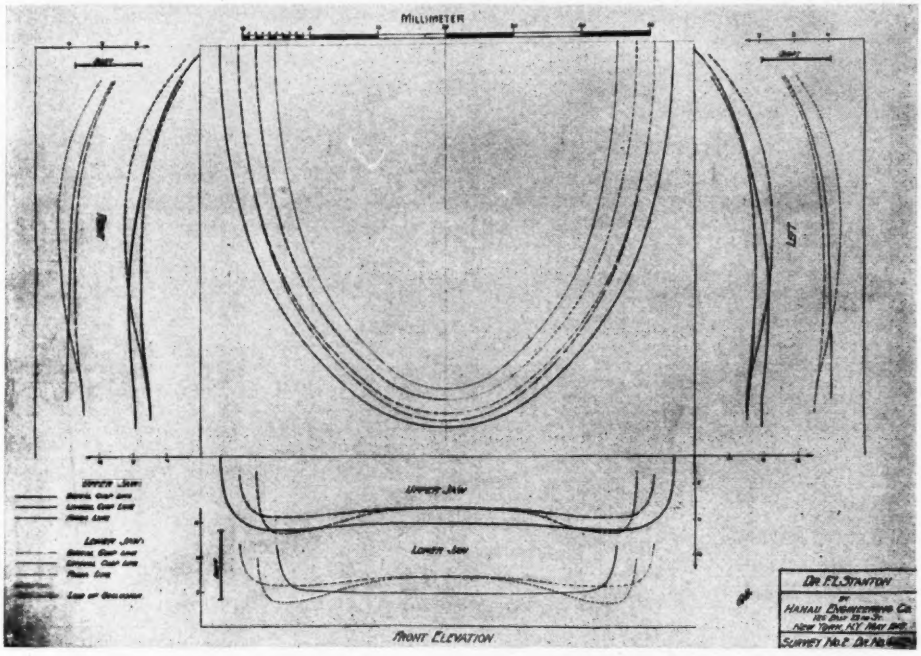


Fig. 24.

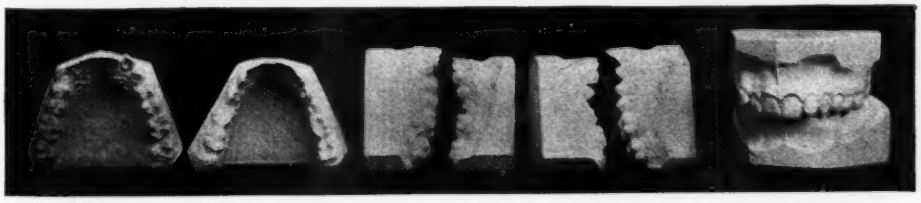


Fig. 25.

Figs. 22, 23, and 24 show models, survey maps, and the ideal curve, respectively, for a case of natural occlusion that was nearly normal. Figs. 25, 26, and 27 similarly illustrate a case of pronounced malocclusion. The surveying for these two cases was done by Hanau.

The surveying process of today involves the use of a mechanism, or kinematic linkage, in place of a method of trial by mathematical curves. The steps in the procedure are as follows:

The models are surveyed with the projecting instrument already illustrated. The maps are enlarged tenfold with a pantograph, shown in Fig. 28. The individual teeth are measured with every precaution under a micrometer

microscope as shown in Fig. 29. The tooth sizes are reproduced, to tenfold scale, in the occlusograph (Fig. 30). The normal occlusion of upper and lower molars and bicuspids, and a suitable overlap relation in the incisal region, are carefully ascertained, so that the cross-link connections of the occlusograph

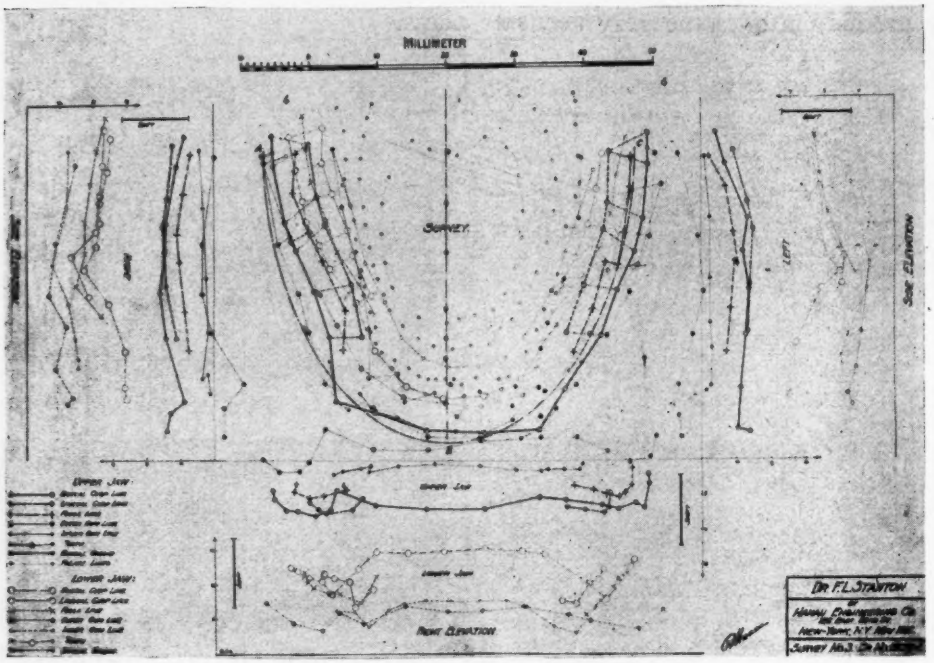


Fig. 26.

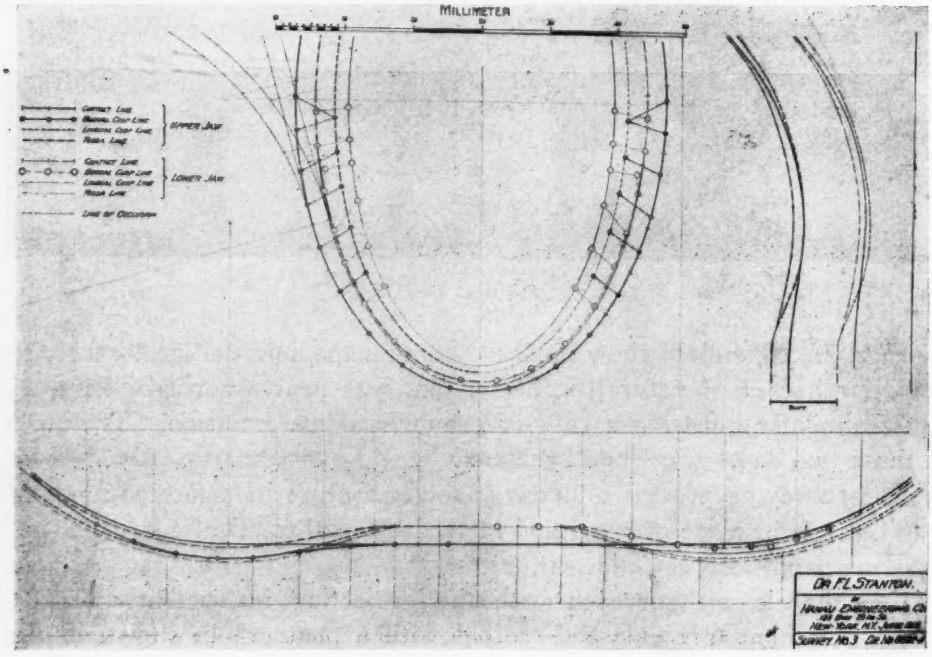


Fig. 27.

Fig. 28.

Fig. 29.

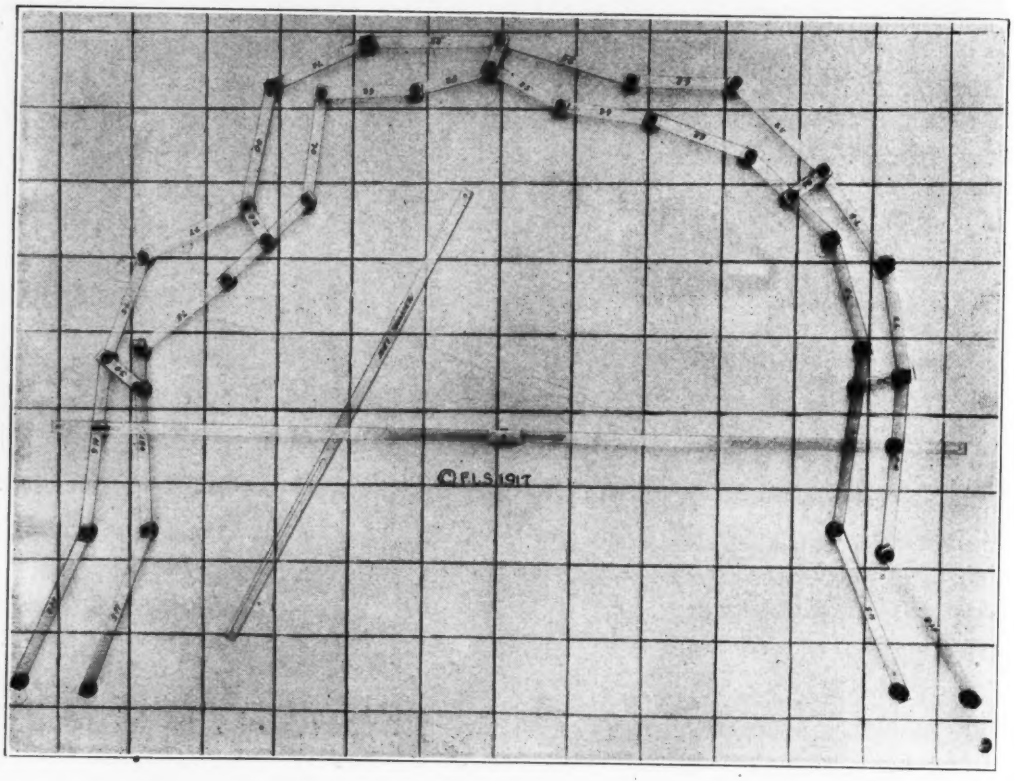


Fig. 30.

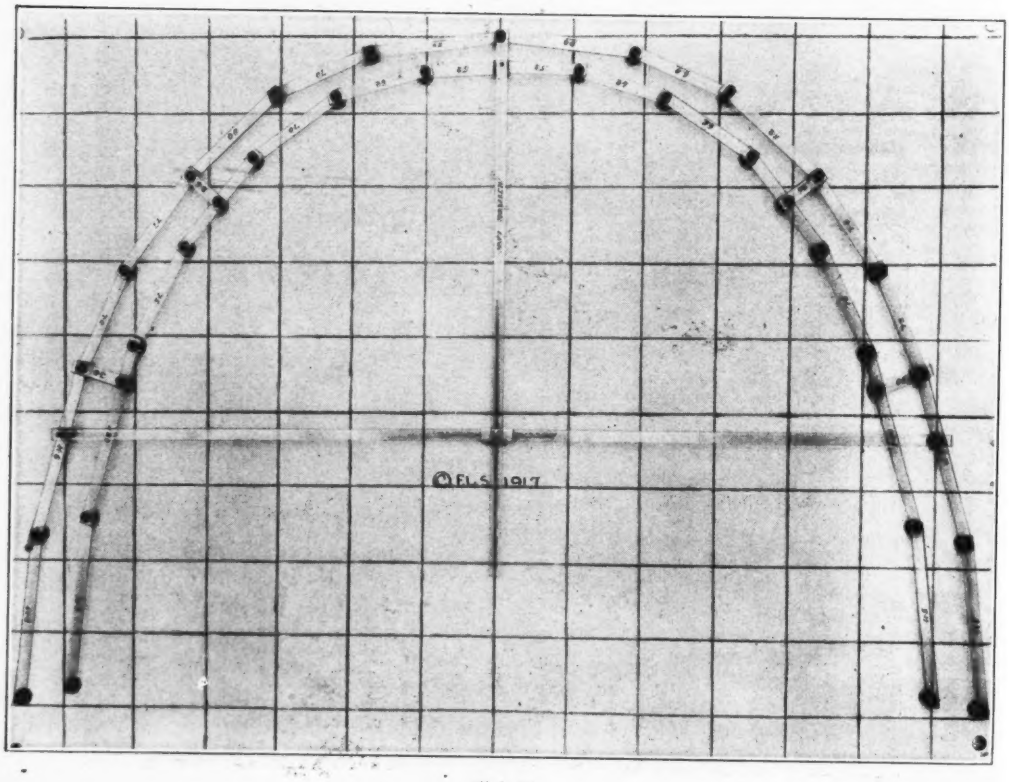


Fig. 31.

shall be determined. The occlusograph is then smoothed out, and semiautomatically establishes the occlusal arch for the case in hand (Fig. 31). The occlusion map, which is made on transparent paper, is placed over the enlarged map of the malocclusion, so as to show the tooth movements required. The pantograph is again used, this time to reduce the composite map of malocclusion and occlusion to natural scale. The final product of the surveying process is a book of plans, showing malocclusion, occlusion, and all tooth movements.

No mention has been made of the supplementary process of showing the vertical, or up-and-down, movements, but the general process includes this phase.

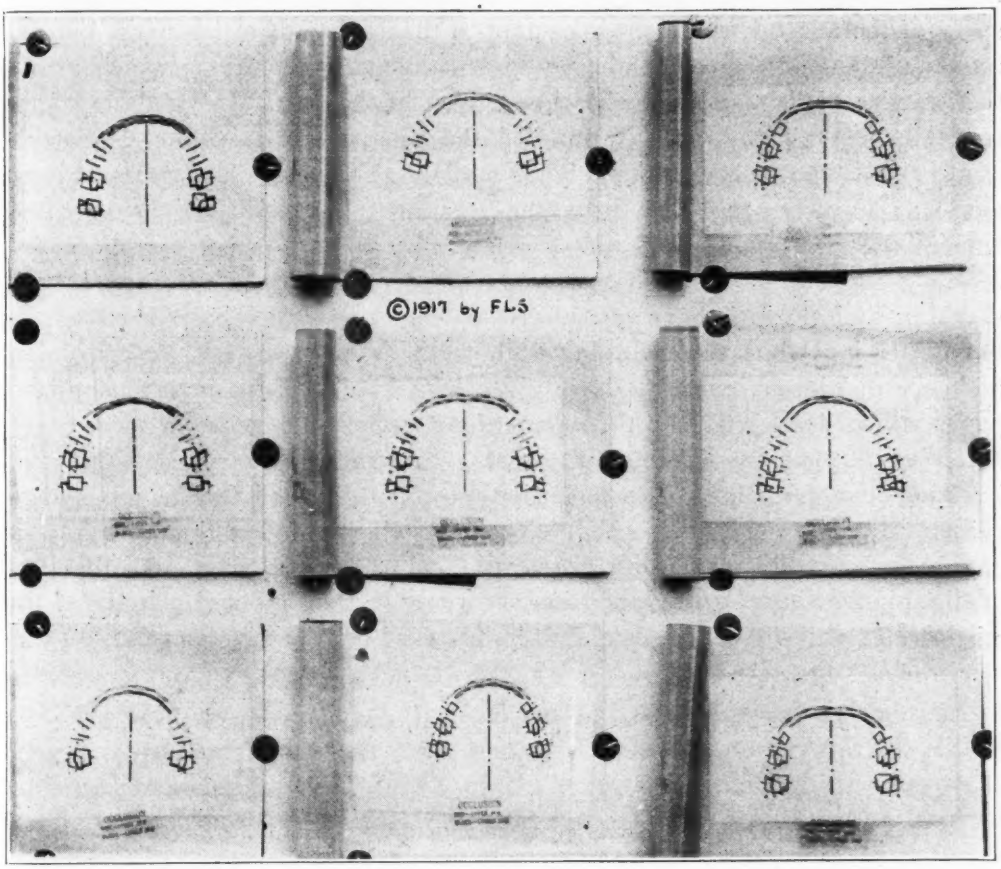


Fig. 32.

Fig. 32 shows nine books of plans, each open at the page on which is the occlusal arch. Note the variety in sizes and shapes. I have heard the criticisms, that these methods were too mechanical and insufficiently biological, and that this hard and fast process made all arches the same shape. Imagine such objections made by men whose only guide to occlusion was the Hawley arch!

One fundamental teaching of the new thought in orthodontia, is to the effect that occlusion is never established by the mere removal of irregularities and the suppression of symptoms. The final solution of the problem must depend on the prevention of malocclusion by early treatment of the deciduous arch.

A CONSIDERATION OF SOME OF THE ETIOLOGICAL FACTORS OF MALOCCLUSION*

By Martin Dewey, D.D.S., M.D., Chicago.

IN selecting as my topic, the consideration of some of the etiological factors of malocclusion, I do so because I believe that the most important part of the study of any pathological condition is its origin or cause. According to this plan, we then place malocclusions among pathological conditions, which may be a manner of considering them that you have not thought of before. Not only is the study of the etiological factors important to the science of orthodontia, but more attention should be given to the study of etiological conditions which arise in the practice of dentistry than has been given in the past. In speaking of dentistry in general, nothing has retarded the progress of scientific dentistry so much as has the lack of the study of etiological factors. The great object in dentistry in times past has been the treatment of conditions as they were found; the correction of deformities and the correction of defects without stopping to consider what has caused these conditions. Papers read before dental societies which have considered etiological factors, have received very little attention while those dealing with methods of treatment have had large audiences. I know because I have given both kinds. Even in orthodontia the paper which deals with the treatment of malocclusion receives a more cordial reception than the one dealing with causes. However, knowing these things and knowing that the cause of malocclusion is still a disputed field, I am going to present to you a few factors which I hope you will find interesting.

In order that I may better present the subject I will begin with the classification of the causes of malocclusion according to the time and manner of their origin, and will follow a plan that is followed in the classification of other conditions.

Conditions, be they normal or pathological, can be grouped as follows:

TIME		MANNER
Inherited Congenital Acquired	CAUSES OF MALOCCLUSION	Local Constitutional

Considering that group of etiological factors as they are arranged under time, inherited conditions may be defined as those arising in the offspring, which have been transmitted from the parent. They include that large group of factors which are impressed on the germ cell, and which are supposed to be a part of the chromatin of the cell.

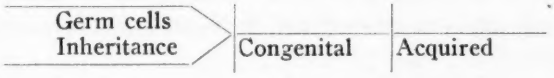
Congenital conditions are those which arise in the individual after the fertilization of the germ cells and make their appearance before birth. They may be inherited or they may be the result of faulty developments arising in the embryo for which the germ cells have not been responsible. They may be the

*From an illustrated lecture before the Alameda County District Dental Society, Oakland, Calif., February, 1917.

result of disturbed conditions in the economy of the mother which has influenced the development of the embryo after conception.

Acquired conditions are those which appear after birth and may be the result of environment. They are always the result of external circumstances and influences.

The relative influences of the three conditions of the life of the individual may be illustrated by the following diagram:



The two lines on the left represent the male and female germ cells which make up the hereditary factors of each individual. At the time of the union of the male and female germ cells, the individual possesses everything that is possible to inherit. Everything which he inherits is also congenital, as the majority of conditions will make their appearance before birth. The racial and anatomical characteristics will appear. The individual will have a certain number of teeth, a certain number of eyes, hands, and feet. All normal anatomical conditions are both inherited and congenital. An abnormal congenital condition is one which arises after fertilization and during development, and which was not present in the parents. Some congenital conditions are developmental factors which occur in every individual, but are lost in the further development, while some become permanent in certain people. Harelip and cleft palate belong to this group. Every child has a divided lip and a cleft palate during development, but they are lost as normal development proceeds. If the clefts persist until birth this is called a congenital deformity. The actual time in the life of the individual when congenital conditions can make their appearance is but the nine months of pregnancy, while the time during which an individual can inherit anything is that period represented by the lives of his ancestors while the factors are represented only in the germ cells. After the germ cells unite, everything is then and there inherited that will ever be inherited.

Acquired conditions arise after the birth of the individual and may arise as long as he lives. It is possible for him to acquire something which he has not inherited, which was not present in the germ cells, and which was not the result of congenital influences. Acquired conditions are therefore the most numerous in the production of malocclusion.

Local conditions are those which affect the teeth and their surrounding structures directly and thereby produce malocclusions. A strictly local cause would therefore have to be an acquired condition.

Constitutional conditions are those which so affect the general metabolism of the individual as to influence the development of the teeth and the surrounding structures. Constitutional factors can, in the broad sense of the word, include inherited, congenital, and acquired conditions. However, from a pathological standpoint they are mostly acquired. Therefore we can divide acquired causes into local and constitutional.

In the consideration of a few of the conditions which have been mentioned, we will first consider those which have been placed under inheritance or have been termed hereditary. The early writing on the causes of malocclusion prac-

tically attributed fifty per cent of the malocclusions which were present to inherited conditions. As the question of inheritance was studied from a biological standpoint it was found that a great many conditions which were supposed to be inherited could not be inherited from a physiological standpoint. It was further found that some of the conditions which had been considered inherited were the result of constitutional conditions which were acquired early in life. However, there are a few factors which are constantly being brought up by some of the modern writers as being hereditary factors in the production of malocclusions which I can not agree with and which I will consider only from the negative standpoint.

The older textbooks laid a great amount of stress upon the influence of the mixing of races, and the intermarriage of different nations in the production of malocclusions. As this country has been settled by people of different nationalities the older writers were supposed to find an abundance of proof in the mouths of American children, and there were a large number of malocclusions present and there are a large number present at this time. In a current number of a leading dental magazine, this old theory has again found space and it is only because I have recently been consulted in regard to this article that I am taking the time to consider this theory. The intermarriage of different peoples has been believed to produce a condition which has been described as large teeth and small jaws, whereby the child is supposed to inherit the large teeth of one parent and the small jaws of the other. Those who support this theory have never explained how such a thing as that could occur. It must be remembered that man is only one part of the animal kingdom and is subject to the same biological laws and the laws of inheritance as any other animal. If it were possible to inherit the large teeth and small jaws, we should see equally as many small teeth and large jaws, which is not the case. If there could be the direct inheritance of parts from each parent, we should find large fingers on small hands and large arms on small bodies and various other abnormal conditions. These we do not find. In the crossing of other species we do not find that certain organs are transmitted directly from one parent and certain other organs from the other parent. There may be a blending of the two germ cells so as to produce an offspring that resembles neither parent; as the mule which is the result of a cross between the mare and jack; as the cattalo which is the cross between the cattle and the buffalo. We do not inherit our organs directly from our parents, Nature does not construct a new individual by taking certain organs from one parent and certain organs from the other, but by the union of the germ cells a new organism is started which must work out its own salvation. It has been proved by experiments on certain of the lower animals, that in the early stages of segmentation the cells have not taken on any definite function in the formation of organs. In the early stages of segmentation, it is possible to separate a frog egg and get two frogs where there should have been but one. This is probably what happens congenitally in the formation of some twins.

Another factor in the production of malocclusion has been termed the inheritance of family traits. Some claim that certain types of malocclusion can be transmitted from one generation to the other with the result that the patients,

will resemble their parents and that they can be identified by the malocclusion they possess. A certain royal family in Europe is always quoted as possessing a certain type of mandible which is supposed to be characteristic of that particular family. There is no question that certain children will have the same malocclusion as one of their parents, and it is also a fact that certain children have the same malocclusion that their uncle or aunt may have. However, that does not prove the inheritance of the malocclusion, for it is very probable that the children have lived under the same environment and have been subject to the same pathological condition as have their parents. In the case of the royal family of Europe that has the peculiar mandible, one will probably find that that particular branch of the family has been subjected to rickets and a certain number of them have also had enlarged tonsils. If you have followed the press reports of that family you will often notice that some of them have been in some famous hospital for the treatment of throat lesion. The type of malocclusion which they possess has not been the result of inheritance, but the result of the acquired pathological conditions which has produced the same type of deformity in all of them.

Another hereditary factor which has been mentioned in the production of malocclusion is supernumerary teeth and missing teeth. At the present time so little is known of the direct cause of the supernumerary teeth, that it can not be stated positively that they are inherited in all instances. We know from a physiological standpoint supernumerary teeth are caused by the development of an extra tooth germ given from the epithelium cord, and from the study made by Black several years ago, is shown that the teeth can be classified anatomically according to the position from which they originate from the epithelial cord. But even that does not explain the real reason for their development. Some men have claimed that supernumerary teeth are the result of atavism, which is the recurrence in an individual of organs and characters possessed by some of his ancestors. Therefore they claim that supernumerary teeth are an attempt upon the part of Nature to supply the individual with the same number of teeth which his ancestors formerly possessed. It is an accepted fact that man has originated from ancestors who possessed more incisors and premolars than man possesses normally at the present time. It is also a fact that the majority of supernumerary teeth are found in the region of the incisors and premolars. Very seldom do we find the supernumerary canines, and if we do find a tooth in the region of the canine it is probably a supernumerary from the incisors or premolar region. Following this rule then, supernumerary teeth in some instances may be the attempt of nature to supply the human family with a greater number of teeth than they now possess, which characteristic is probably inherited from ancestors years ago. However, there are no authentic cases which show the supernumerary teeth have been handed down from generation to generation without an interruption anywhere along the line. Missing teeth have also been considered as coming under the influence of inherited factors and possibly in some instances missing teeth are inherited. They are also considered as being the attempt of Nature to further reduce the number of teeth in man, and this is substantiated by the fact that the missing tooth is more

often a lateral incisor or a lower premolar. However, one objection to the theory of missing teeth being produced by the tendency of Nature to reduce the number of teeth in the dental apparatus is found in the fact that Nature does not seem to be positive as to which tooth she wishes man to lose. As I have stated the teeth most often missing are the lateral incisors and the premolar, and late investigation seems to indicate about ten per cent of the children of today have missing one or more teeth. Whether this estimate is too high or too low will probably be proved later by a collection of radiographs which are being collected by different men in different communities. In considering missing teeth it must be remembered that there are certain types of missing teeth that are purely congenital which are produced by the lack of development of the tooth germ without any cause being transmitted from the parent. We must also remember that missing teeth may be acquired which may be a local condition wherein the missing tooth is lost early by the extraction of the deciduous tooth, or where the tooth germ is broken up by a long continued fever or constitutional disturbances which may be present in certain diseases of childhood. Therefore it is unsafe to say that all cases of missing teeth are influenced by inheritance, for taking the law of average one would expect to find only one-third of them influenced by inheritance whatsoever. In closing the remarks in regard to inherited malocclusion, I will state that at the present time the inheritance of malocclusion is considered as a rather negative standpoint. A great many conditions which were supposed to be inherited have now been found to be the result of acquired conditions either locally or constitutionally which now can be understood if analyzed, and therefore the question of inheritance plays a very small part at the present time.

Of the congenital conditions which produce malocclusion there are a few which might be mentioned briefly. Harelip and cleft palate are congenital conditions which may arise in any individual and which seem to be influenced by environment and in some instances by inheritance. However, there is very little to prove the truth or substantiate the fact that cleft palate is directly transmittible. We know of a great many instances of children born from parents who have harelip or cleft palate and the children are perfectly normal. We also know of a great many children with harelip and cleft palate who have been born of perfectly normal parents. Owing to these facts creeping into the argument it is quite impossible to build a strong structure on the theory of inheritance in the production of harelip and cleft palate. If we were to examine a large number of such congenital conditions, we would find that out of a thousand people, regardless of where they were located, regardless of their race or conditions, there would be about the same number of cases of harelip and cleft palate, providing the people or parents were living under similar circumstances.

It has been observed that children who are born of mothers who are forced to do manual labor during pregnancy or are more or less underfed, are more apt to have harelips and cleft palates than the children of mothers who have had the proper food during pregnancy and who have not been compelled to tax their systems by the performance of active manual labor. It has also been proved that the first-born child is more apt to possess a harelip and cleft palate, which

may be influenced by the mother lacing tightly and wearing tight clothing to hide the pregnancy. This habit has the tendency to force the developing mandible between the parts of the maxillæ and thereby hold the maxillæ bud away from the frontal nasal bud with the result that the parts never become united. While we do not know as much about harelips and cleft palates as we should, we do know that it is a congenital proposition and has probably been produced by something in the life of the child which has interfered with the union of the parts and is not the result of inheritance except possibly in a small percentage of cases.

Another cause of malocclusion which we do not know enough about, is the abnormal frenum. This is the attachment of the upper and lower lip to the gum tissue at the median line. Either the upper or the lower frenum can be abnormal, but the abnormal condition is more prevalent in the upper arch than in the lower; however, I have seen the lower frenum abnormal when the upper was normal. Ordinarily the frenum stops at a point gingivally to the gingival gum tissue which would be about one-third of the distance of the length of the root from the gum. In certain individuals it will be found that the frenum extends in between the central incisors passing lingually to a point slightly anterior to the anterior palatal foramen. In these cases of abnormal frenum, the frenum is quite dense and contains a great amount of connective tissue greatly resembling other ligaments of the mouth. In these cases we find the frenum is so large that every time the lip moves, pressure is exerted on the mesial side of the central incisors and tends to separate them. The exact cause of the excessive development of the frenum is not positively understood, but in the majority of cases is probably congenital. In examining a number of young children before the eruption of any of the deciduous teeth, it will be found that the frenum is always extremely large as compared with the normal in the adult and is attached to the occlusal border of the gum tissue. In following the eruption of the deciduous teeth and the development of the alveolar process, it will be found that the frenum seems to diminish in size, and the alveolar process grows occlusally away from the attachment of the frenum. However, if the frenum should continue to exist and remain attached to the occlusal margin of the alveolar process, it will eventually separate the incisors, and therefore become an abnormal condition. The abnormal frenum seems to be the continuance of a point of attachment, which is present in the young child but which disappears or changes as the child grows older. I do not know that all abnormal frenums are congenital and have often seen some that appear to be acquired for there was no evidence of them prior to the eruption of the permanent teeth. However, it may be that in those cases, the frenum has always been present and was only noticed after the deciduous teeth were lost.

In taking up the study of acquired causes, we reach a group of conditions, some of which are thoroughly understood and some of which are not understood at all, and which are quite numerous. In considering acquired causes as well as the consideration of inherited and congenital causes, I wish to impress upon your minds that anything that causes malocclusions does so by disturbing one of six forces of occlusion. There are six forces or factors which are responsible for the teeth assuming and maintaining definite positions in the

dental arch. They are as follows: Cell metabolism, force of approximal contact, the force of the inclined plane, muscular pressure, harmony in the size of the arches, and atmospheric pressure. If all of these six factors are working normally and continue to remain normal during the life of the individual, the result will be a normal set of teeth. However, if any one of these factors becomes abnormal any time in the life of the individual, a malocclusion will be started; and if the abnormal force continues, the malocclusion will be progressive and will continue to become more marked until the teeth become locked in an abnormal position by some other force of occlusion asserting itself sufficiently to hold the teeth in the malposition. This means that every person, regardless of how old he may be, can develop a malocclusion any time in life if some of the forces of occlusion become wrong. In considering acquired causes of malocclusion, we may then say that all of them produce malocclusions by interfering with some of the forces of occlusion.

One of the acquired causes which I wish to mention is faulty nutrition, which may begin as a congenital condition in the faulty nutrition of the mother during pregnancy or which may begin as an acquired cause early in the life of the individual because of the lack of proper foods during early childhood. We have already stated that if mothers are underfed and overworked, harelips and cleft palates are apt to occur in their children, and in a great many of these cases one may find malocclusions making their appearance later in life.

As a result of faulty nutrition of the child, it has been shown through study made by Hellman that there is a greater tendency for malocclusion to develop in bottle-fed babies than in breast-fed babies. There is no doubt that the bottle-fed baby does not receive the proper nutrition because it is practically impossible to modify or produce artificial food which would be as suitable for the child as the mother's milk would be, provided the mother is healthy. One reason for the great tendency to malocclusion in bottle babies is caused by improper nutrition and improper use. By use, we mean that in order for the dental apparatus to develop properly, the mandible and the maxillæ from the time the child is born, as well as the muscles associated with them, must perform the proper function. In all children it may be observed that the mandible is quite small as compared to the rest of the face. The mandible is a bone of environment and will develop with proper use. If it does not have the proper use there will be a tendency for the mandible to remain underdeveloped and as a result of that the malocclusion will make its appearance later in life. With a babe who is nursing the breast during the act of nursing he bites and chews the nipple and necessarily exercises the muscles of mastication, the muscles of the lip, the muscles of respiration with the result that much stress is brought to bear upon the mandible and the maxillæ as well as the force on the nasal structures. If the child is a bottle-fed baby the bottle is placed in such a position that he obtains his nutrition without any special effort, and as a result the muscles of respiration and mastication do not receive their proper function, and therefore the mandible remains underdeveloped. The question of use is also a factor, which continues throughout the life of the child, or at least through the time of eruption and shedding of his deciduous teeth. The modern child is not edu-

cated to masticate his food, because the food, in most instances, is of such a type that it does not require mastication. Therefore we find that mastication is discouraged and as a result of that the mandible and the maxillæ are not properly developed and they do not grow sufficiently large to accommodate the permanent teeth even if the deciduous do succeed in getting in their proper position in the dental appartus. The question of mastication as a factor for developing the mandible has been recognized by Ferris, of New York, who has made a number of experiments along this line which are very interesting and which prove conclusively that active mastication is a great factor in the developing of the mandible and the maxillæ and can be produced by masticating exercises which he has been trying with some of his patients. The effect of use on the development of the mandible and maxillæ can be very easily shown by comparing the skulls of the race of the people who require mastication with the skulls of those people who do not require mastication. The skull of the man who was forced to masticate his food shows a well developed mandible and maxillæ, while the skull of the man whose food does not require mastication shows a much lighter alveolar process, a much less developed mandible and maxillæ, and in the majority of cases, the teeth have some type of malocclusion.

Under the head of acquired conditions, I also want to mention constitutional disturbances for there is a tendency on the part of some men to claim all malocclusions are caused by local conditions and developed from purely mechanical factors. However, there are some malocclusions which are the direct result of faulty cell metabolism which is produced by certain constitutional diseases. Of the constitutional diseases which produce malocclusions we have rickets and tuberculosis. These diseases are quite common and have played a part in the production of a great many cases of malocclusion, and have never been recognized as having anything to do with the case, and in some instances they have not even been recognized as being present in the patient at all.

Rickets, which we will consider first, is a disease of malnutrition characterized by faulty bone development. In fact the faulty bone development is so common in this constitutional disease that it has been called a disease of the bone. However, later investigations show that all of the tissues and organs are affected to a certain extent, and that the faulty bone development is only the result of the malnutrition. The disease has also been considered as a disease of childhood, but it has been shown that it may also occur in adults. It is particularly liable to occur in pregnant women and in nursing mothers. If present in nursing mothers, it is obvious that the effect on the nursing child would be anything but satisfactory. The general symptoms of the disease are many, but I will only mention those that are associated with the teeth. In young children, one of the first dental symptoms is the tardy eruption of the deciduous teeth. Some men have claimed that if the first deciduous tooth does not erupt in nine months, the child is probably rickety. Along with the tardy eruption of the teeth will be an abnormal tenderness of the gums which may be large and puffed, showing evidence of inflammation. After the eruption of the deciduous teeth, they will be lost early, that is, if the disease continues. It must be remembered that the child may be normal at the time of the eruption of the deciduous teeth and the

first set of teeth will appear at the normal time. After their eruption the child will become rickety and the deciduous teeth will be lost too early. In those children who are suffering with rickets, the roots of the deciduous teeth absorb without any apparent reason. However, there is a reason and that reason is undoubtedly the great need in certain tissue for salts, and that need is partly supplied by the early loss of the deciduous teeth. That the absorbed root of the deciduous tooth has nothing to do with the development of the permanent tooth is proved by the fact that in these cases of the early loss of the deciduous tooth it is followed by the tardy eruption of the permanent tooth. The early loss of a deciduous tooth for any reason will result in the production of malocclusion regardless of what causes the loss. If this early loss is complicated by the tardy eruption of the permanent tooth, we still have a greater chance for the malocclusion to occur. The late eruption of the permanent tooth is again caused by the faulty nutrition. Along with these conditions which we have mentioned in regard to the eruption of the teeth, we find a faulty development of the alveolar process and the bones of the mandible and the maxillæ. The process contains a large number of spaces which are filled with an imperfectly calcified material resembling cartilage. Instead of the gingival marginal ridges of the process being but a small edge of bone, the margin is greatly thickened and rounded. In examining the patient's mouth, one will be impressed with the thickness of the alveolar ridge. This thick ridge is not an evidence of strength, but is the result of imperfect calcification. Rickets may be a contributing factor to any type of malocclusion or it may be the primary cause. One of the conditions or deformities which is the direct result of rickets is a very narrow upper arch with thick alveolar ridges to the lingual of the teeth. The lower arch is often wide with the apex of the molar and premolar roots turned to the buccal making a very wide mandible. As the mandible is poorly developed, it is deformed as the result of muscular pressure. As force is brought to bear on the teeth in mastication and as the muscles of mastication pull on the weak and poorly developed mandible, the mandible is bent upward in the region of the attachment of the masseter and internal pterygoids, which has the ultimate result of making a straight mandible in the region of the angle between the ramus and the body. As a result of this, the chin becomes unduly prominent and presents the characteristic "under shot" mandible so commonly seen, and which has been attributed to inherited family traits, but which is the direct result of rickets.

It must also be remembered that rickets is not a disease limited to any particular class, but may be found in the richer classes as well as the poorer classes. It must also be remembered that rickets associated with other conditions may produce malocclusion or simply complicate the matter and make the condition much worse than it would be otherwise. One of the symptoms of rickets which must be observed is the tendency toward large thick congested gums, and thick alveolar ridges. The teeth are prone to move very easy and one must be careful in making a prognosis, for while there is no doubt but that the teeth can be moved, there also is no doubt but that they will move as rapidly to positions of malocclusion.

Another constitutional condition which produces malocclusion is tuberculosis, and which acts directly the opposite of rickets; namely, the child who is tubercular will cut the teeth early, the deciduous teeth will be retained too long, and the permanent teeth will erupt practically on time. The principal malocclusion which will be caused by tuberculosis is a diverting of the permanent teeth as a result of the prolonged retention of the deciduous teeth. As to the seriousness of the malocclusion as produced by the constitutional diseases mentioned, I will only say that rickets produces much more unfavorable conditions than tuberculosis.

Another factor which enters into the discussion of a large number of malocclusions is what has been termed disuse. By disuse is meant the lack of use of the teeth as organs of mastication during the time the child is growing, and during the time the teeth should receive vigorous usage. It is a well known fact that any organ to be developed must receive the proper use, for use produces the proper circulation of blood in the parts as a result of which the parts develop. The deciduous teeth may be said to have two important functions. The first one is to act as organs of mastication during the early life of the individual, the second is to act as stimulating factors in the production of growth in the bone in order that the permanent teeth may have sufficient space when they erupt in the dental arch. If the deciduous teeth are not used as they should be used the permanent teeth will not erupt in their proper position owing to the fact that the bony structures supporting them are not developed sufficiently large to accommodate them. Of all the factors that have tended to produce malocclusion in the civilized man, I will say that the disuse of teeth probably plays as much of a part as any of the others. In other words, if every child were compelled to use his deciduous teeth in the manner which Nature designed them to be used there would be a far less number of underdeveloped arches than is found at the present time. As a result of this prevailing malocclusion in the modern child one may say that malocclusion is almost a disease of civilization—not as a result of civilization, but as a result of the environment under which civilized people live. In other words, if the civilized child were compelled to use his teeth in the manner for which they were designed, he would be no more liable to malocclusion than the savage child who is compelled to use his teeth for the purpose for which Nature gave them to him.

The effect of mouth breathing as a factor in the production of malocclusion has long been recognized by the dental profession and there is no question but that long continued mouth breathing will produce deformities of the dental apparatus, consisting of a narrow upper arch, protruding upper anterior teeth and an underdeveloped mandible with a receding chin. The principal cause of mouth breathing in children is the hypertrophied lymphoid tissue located in the nasopharynx, which is commonly termed adenoids. This mass of lymphoid tissue has always been more or less of a disputed organ as regards utility and function in the growth of the individual. Some men have claimed that the adenoid tissue of the nasopharynx plays a very important part in the growth of the child, acting somewhat in the nature of the ductless glands, while others seem to think it has no particular function and act accordingly. As far as my

observations go I have never observed any evil effects in children who have had their adenoids and tonsils removed in early life. Some men have claimed that the removal of the tonsils will produce a lack of development in the dental apparatus, but I have not seen this occur. In fact, some of the worst developed dental apparatus I have ever seen have been in children who had normal adenoids and tonsils. We do know that hypertrophied lymphoid tissue produces nasal obstruction and resulting malocclusion, but we do not know that its removal has any detrimental effect on the dental apparatus. Therefore, I am inclined to believe that in those children where the lymphoid tissue has hypertrophied and the tonsils are inflamed, I would rather have the tissue removed and take a chance of abnormal conditions being produced by their removal, than to have them remain when it is absolutely certain that a pathologic condition is no help to the child, and it is almost certain to produce some type of malocclusion.

The diseases of the ductless glands have attracted considerable attention of late and there seems to be no question but that the ductless glands have certain influences on development, and that pathological disturbances originating in them produce certain types of malocclusion. We very often observe abnormal growths in the jaws at various regions. They seem to occur without any definite reason and are probably the result of some disturbance of the ductless gland that we do not know enough about at the present time to decide on any real scientific and specific treatment. I have seen cases where the bite would begin to open in the incisor region without any apparent reason, also cases where the occlusion seemed to be normal and all of a sudden, without any particular reason, the mandible would begin to develop before the loss of the deciduous teeth and produce a malocclusion the treatment of which seems very hopeless at the time being, because the exact etiology of the condition is not known. Therefore one of the prime needs of orthodontia today is a more complete study of etiological factors because solving etiological factors in any pathological condition is a great step towards the satisfactory treatment of the trouble.

In closing, then, let me make a plea for more careful observation of the things that may cause malocclusion. For real science is based upon the fact that we know first what causes the condition, and after we know the causative factor, the treatment becomes much more easily understood.

FACIAL IMPRESSIONS AND CASTS

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Part III.—The Full Facial Cast with Insert.

THIS phase of the discussion of the work on the treatment of facial casts and impressions is merely an outline of the construction of the front facial cast plus the insert, which, by the way, is a very valuable addition. The insert is a plaster replica of the teeth when in a normal position, and when this representation of the teeth is properly molded and correctly placed within a plaster cast of the full facial view, it shows the outside of the face of the patient, exposes to view the teeth normally closed, and gives the relative position of the teeth and jaws with all defects in evidence.

The construction of this cast is far more intricate than that of either of the foregoing impressions; in fact, this construction is practically the same as that of the front facial cast much elaborated by the addition of the insert. The first thing to be done is to make a full facial cast, beginning with the top at the coronal suture, taking in the eyes and ears, and at the bottom, including the front part of the neck. In the construction of as large a cast as this, it is necessary for the patient to lie on a table, for if a chair were used, the slope would cause the plaster to run down the neck and it would be difficult for the operator to apply plaster to cover the ears. Small rubber tubes are used to facilitate the breathing during the operation, as usual, vaseline covers the face before the plaster is put on, and the work is the same as in the front facial cast with the addition of some few details.

Since the ears are to be included in the impression, cotton must be placed in them to prevent falling plaster from injuring the drums, and a small cotton roll should also be placed behind the ear to keep the weight of the coating from pressing it against the head, as well as to aid in the removal of the impression. When the pasteboard frame is used, it must be large enough to fit around the head well back of the hair line, back of the ears, and down the sides of the neck. The plaster is easier to manage if the frame is bent rather in the form of a scoop to keep the wet coating from escaping its bounds and going down the neck. An assistant to hold the pasteboard in place will not be amiss and will enable a better handling of materials. When the plaster has been put on, hardened, and removed, the impression is then painted with two coats of shellac and one of sandarac. The impression is then carefully laid away for the cast is not poured until the insert is made and fastened in position within the full facial impression, when the impression as a whole is filled with plaster.

The next thing to be done is to make the insert for the cast. The preliminary arrangements as to breathing apparatus, etc., are the same as in the full facial cast, but in this case no portion of the face need be included excepting the center forehead, nose, mouth, and chin. The patient should close the mouth and teeth normally and this natural position must be maintained throughout the whole procedure. With the forefinger of the left hand the operator should separate the lips and hold them away from the teeth far enough that a soft

plaster mix may be worked well between the lips and the teeth. Care should be taken to cover thoroughly all of the teeth as far back as they extend, and even a little farther, finishing one side at a time, and then coating the front well up under the lips. After the interior of the mouth in front of the teeth is filled with plaster, work is begun on the exterior and the features to be included in the impression are covered (Fig. 11).

When the plaster has set, the outer part of the model may be gradually loosened and removed by breaking it away at the lips. That portion of the impression which is within the mouth can not be taken out in one piece, but will usually divide into two or three parts. These parts of the impression may be reassembled by the use of a small amount of sticky wax. A varnish, first of shellac and then of sandarac, when the blemishes have been removed, produce the impression of the insert ready to be poured (Fig. 12).

Before the cast is poured, a small cotton roll is placed between the teeth and the outer wall of the impression to prevent the plaster from filling the intervening space (Fig. 13). When the pouring has been completed and the plaster walls cut apart in the usual manner, the insert proper is finished. There is no necessity for this whole model to be used in obtaining a plaster reproduction of the teeth only, but in order to place the insert properly in the full facial cast, some chief points are needed. Therefore, it is a good plan to cut away the exterior features of the insert with the exception of the tip of the nose, the central part of the forehead, and the projection of the chin, leaving only the teeth with these points as guide posts to location (Fig. 14).

When the entire cast with insert is completed, the exterior of the mouth is shown on the one side of the face, while on the other, a piece of plaster has been cut out showing the teeth as they appear inside the mouth. A removable wax block molded to follow the contour of the mouth on the outside, is fitted into this open space, so that when in place, the whole outside of the mouth is seen, and when removed, the teeth are exposed on that side. It is a delicate task to fit the wax perfectly to conform to the imprint of the teeth, and yet on the outside, to take the shape of the lips. To fit this block, the insert is temporarily placed in position in the mold of the face as a whole. With a pencil, marks are made to indicate where the projections of nose, forehead, and chin fit into the corresponding depressions in the unpoured facial impression. Then, when some wax is applied to the side of the insert to be used, the block is gradually built up. By following the pencil marks from time to time, the plaster insert with the wax addition is put in place, and with many careful trials the wax will soon fit into its place. The application of a little heat to the wax will give it the right constituency making it malleable enough that when the insert is in position, the wax may be pressed firmly between the mold of teeth and lips giving it the impression of both (Fig. 15).

The insert must be held in its exact position while the mold is being poured, so for this purpose a special device is made. This retainer consists chiefly of a curved piece of steel about a quarter of an inch in diameter and twenty-six inches in length, a crossbar of steel about eleven inches by three-quarters by one-half inch, and a set screw about eight inches long and one-half inch or less in diameter. The ends of the round piece of steel are cut in threads for five or six

Fig. 11.

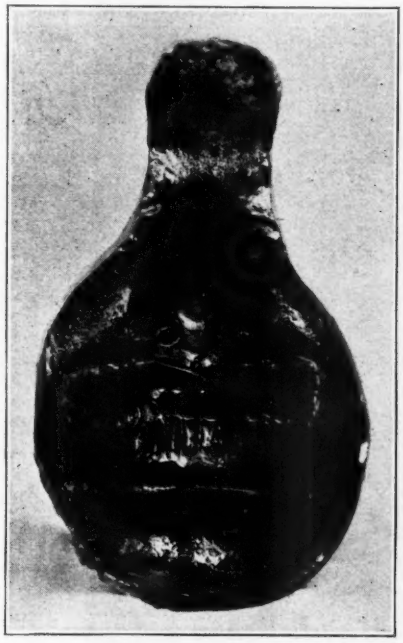

Fig. 12.

Fig. 13.

inches, and these ends pass through slots one and three-quarters inches in length cut in each end of the crossbar. In the center of this bar is passed the set screw (Fig. 16).

When the apparatus is complete, the curved piece of steel is placed around

Fig. 14.

Fig. 15.

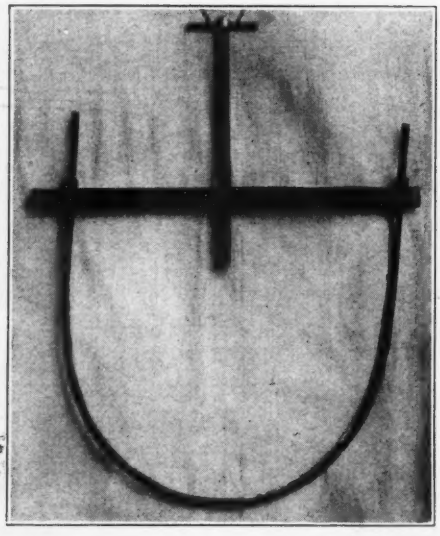

Fig. 16.

the center of the impression and bent to conform to the outer surface. Notches are cut in the plaster on either side of the impression about the height of the ear, and one in front about the location of the mouth, and on these rest the curved piece of the retainer. The insert is carefully placed inside the outer

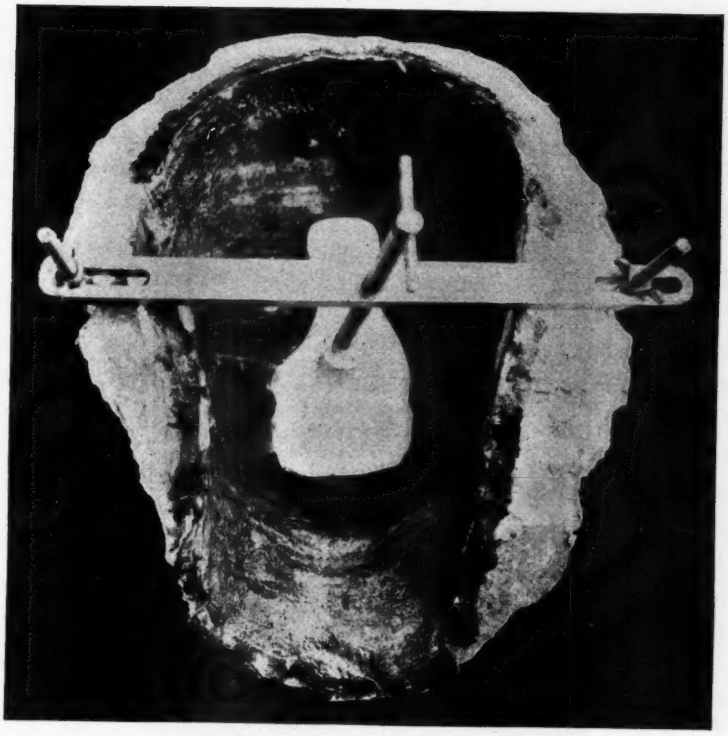

Fig. 17.

Fig. 18.

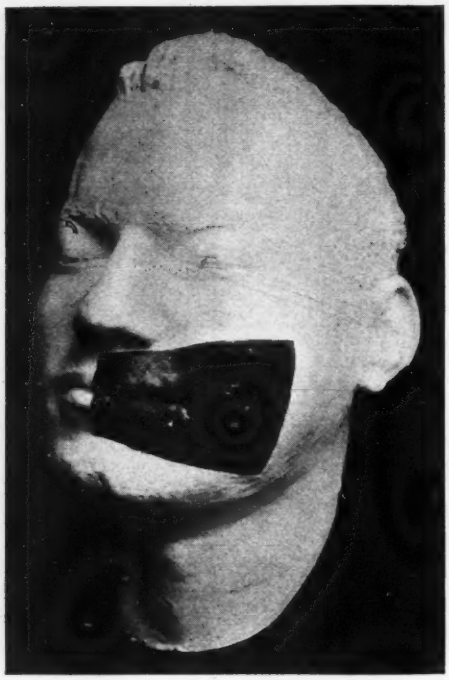

Fig. 19.

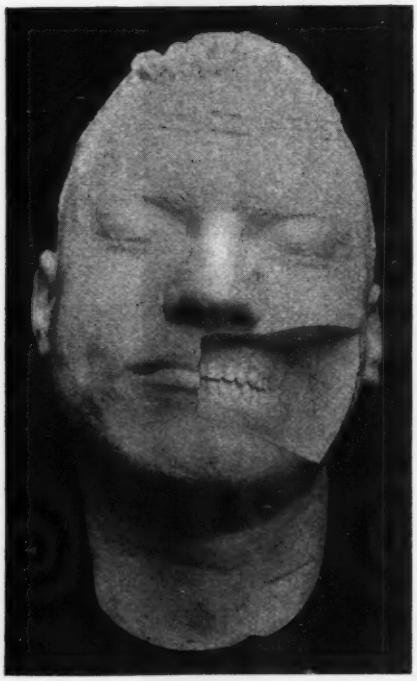

Fig. 20.

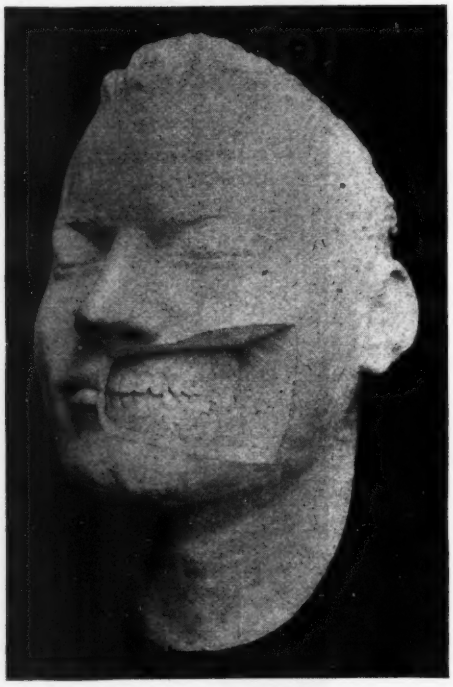

Fig. 21.

impression and the wax block takes its correct position. The placing of these is extremely important, as their location now is permanent. A cork is inserted in the back of the insert in order that the thumb screw may be fastened securely All is in readiness now for the adjustment of the steel device.

The curved piece of steel rests in the notches, and when the threaded ends pass through the crossbar, they are held tight with nuts and the thumb screw is screwed into the cork until there is no danger of the insert slipping from position (Fig. 17).

A thin mix of plaster is poured into the mold and a soft brush is used to work well down into crevices. The cast with the insert is so heavy that there is no easy way to manage it without the introduction of some outside instrument, therefore, after the surface is entirely covered with plaster, a round piece of wood or iron is fitted into the back of the cast about opposite the ears (Fig. 18). This serves as the necessary handle for the convenience of the operator. When the bar is in position, a second mix of plaster is poured in, and when it has hardened the impression is marked off in sections (Fig. 4, Part I) and carefully separated. The separation accomplished, the finished cast appears with the wax insert in place (Fig. 19). This wax block is easily removed by simply working it loose, and the complete full facial cast with the insert remains (Figs. 20 and 21).

DEPARTMENT OF
DENTAL AND ORAL RADIOGRAPHY

JAMES DAVID MCCOY, D.D.S., EDITOR,
LOS ANGELES, CALIF.

CONCERNING BRIDGES

BY GRAY C. BRIGGS, M.D., ST. LOUIS.

A MAN consults a dentist. He has a bridge which is sensitive to pressure. There is no sharp or constant pain but rather a tenderness that is manifested on mastication. To treat this properly the dentist must have some accurate knowledge as to the causative element. He considers the possibilities. It might be that the trouble comes:

1st. From a tooth forming one of the abutments. It might be caried, or abscessed. There might be a granuloma or a pulp stone.

Fig. 1.—Observe in this case the ravages of pyorrhea. Note how the alveolus is absorbed above the crown on the molar and see the almost complete absence of attachment between the roots of the tooth forming the posterior abutment and the bone.

2nd. From an irritation produced by the bridge itself. It might be impinging on the gingiva; there might be a faulty adaptation of the band; an excess of cement might have been used which forced down under the crown and, hardened, is cutting the gum.

3rd. From some pathology of the alveolus. An unerupted tooth, an impaction, abscess formation, cyst, or perhaps an odontoma is forming.

4th. From mechanical errors in technic. The span may be of too great

Fig. 2.—Les enfants terribles: These two small root fragments, shown under the bridge, are the remains of a second molar incompletely extracted prior to the time the bridge work was done. Note the infection and absorption, and that the posterior fragment is being thrown out, impinging on the bridge.

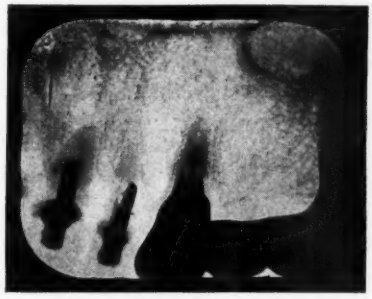

Fig. 3.

Fig. 4.

Fig. 3.—A case from the practice of Dr. Charles Grosby. No trouble was found in the immediate region of the bridge. Observe in the porcelain crowned tooth just in front of the bridge how the post perforates the side of the tooth and has caused absorption. This was clearly a case of reflex irritation.

Fig. 4.—Notice the caries and absorption of alveolus between the two molars. Also that the canal of the bicuspid is unfilled, though no trouble has resulted therefrom.

Fig. 5.

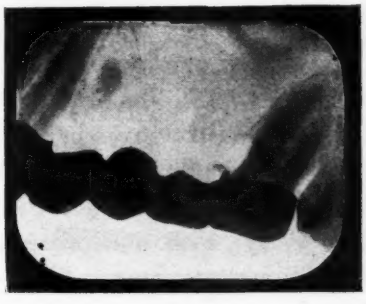

Fig. 6.

Fig. 5.—Observe the gutta percha point above the apex of the central. A discharging sinus which had existed over a period of years was fed from the alveolus between the lateral and the bicuspid. This absorption area is shown on the roentgenogram and is of considerable proportions.

Fig. 6.—In this case the irritation was caused by a bit of hardened cement clearly shown mesial to the second molar. In putting the crown on the abutment this excess cement was not removed. A gingivitis and resulting sensitiveness was produced.

length. A cantilever bridge of excessive leverage may have loosened the supporting tooth.

5th. From reflex irritation; the tooth causing the disturbance may be wholly dissociated from the bridge.

There are other causes, too. Occasionally cases wierd and wonderful appear, cases which would never under any circumstances be properly diagnosed without the agency of the roentgen ray. There are cases too which wander with

Fig. 7.—This case from the practice of Dr. Bartlett and Dr. Loeb we were unable to diagnose. We reported that a shadow consistent in size and shape with that which a tooth might make was observed under the bridge. It evidenced no root canals, however, and had no space for the peridental membrane. We asked to be advised if the pathology was ever ascertained. A few days later Dr. Loeb stated to the writer that the case had been operated and the shadow in the roentgenogram was produced by a calcium formation in the socket of the first molar. Since the time this film was made two other identical cases have been examined.

growing dispirit and distrust from dentist to dentist, to physician, and back again to dentist without relief, not because any inability to treat the case exists but because no accurate conception of the causative element has ever been obtained.

I have selected from my files a few of these bridge cases to show how simple the diagnosis sometimes becomes when the case is subjected to a roentgen examination.

THE X-RAY PICTURE GALLERY

By B. Frank Gray, D.D.S., Colorado Springs, Colo.

WHEN visiting one of our large cities a year ago, I was surprised to learn that many members of the dental profession were depending on men outside the profession to diagnose for them, or aid them in diagnosing, the pathology of the teeth and their investing structures.

Only fully qualified and regularly licensed dentists and physicians should be allowed to render radiographic service.

The x-ray, with our present understanding of its nature and application, granting all its advantages, is a dangerous agent. It is capable of producing injuries of a grave character, both to patient and operator. One need not go out of his own immediate community to verify the truth of this statement. Certainly, on the ground of the best interests of the public, it should not be possible for patients to secure services of this character at the hands of uneducated, unqualified and unlicensed persons.

The value of radiographic findings depends upon the clinical evidence attaching to a given case, upon a knowledge of the anatomy and pathology of the parts pictured, upon a proper interpretation of the films or plates, upon the angle at which the picture is made (known only to the operator), upon the intensity of the ray, and upon numerous other considerations. Thus it may be seen, the work being done in many of these x-ray picture galleries is purely a mechanical procedure, and the opinions of the operator are without value to the dentist.

These men actually solicit the x-ray work from dentists at a stipulated price per month, agreeing to do all work sent them. I have noted "quotations" as low as $7.50 a month for such an arrangement! What an opinion these men must have of the dental profession! Unless some of its members have a care, they may justify the opinion in which they are evidently held in certain quarters.

Again, all too frequently, films are loosely mounted on cards,—four, six or a dozen to a card. Should they become transposed in their positions, as is so perfectly possible, it is not difficult to imagine the serious results that may follow. All films passing out of an x-ray operator's hands, should be accurately labeled, and firmly enclosed (together with the labels) between glass plates, where they can not be tampered with.

Those professional men who patronize these mushroom x-ray establishments, must place a very low estimate upon the requirements of high class radiographic services, and upon the dignity of their own profession. In some quarters the roentgen ray is in disrepute, and I have outlined in this brief paper the chief reason for it. The time is opportune for a "Right about—Face!" in this matter, and I hope members of the dental profession may awaken to their responsibility.

As a matter of fact, the use of the roentgen ray in the professions of medicine and dentistry, should be *legally defined* as actually constituting the practice of medicine or the practice of dentistry, as the degree held by the operator may determine. Then, and not until then, will this important work receive its rightful status.

"Stop—Look—Listen!"

SINCE the message was sent broadcast by a few investigators in the field of root pathology that apical foci of infection were responsible for the onset of chronic infections in remote areas of the body, *thousands of teeth have been uselessly sacrificed.* It has been the experience of a number of practitioners, the writer included, that the conclusions of enthusiasts in the field are not *always* warranted by the clinical results secured in many chronic cases following the removal of presumably infected roots. Case after case could be summoned in support of the contention that root pathology in its bearing upon the development of systemic lesions is as yet in semi-obscurity and that the so-called focus of infection upon or adjacent to a tooth root is not to be construed in every instance as the only source of a generalized disturbance. This conclusion is reached after having observed a weighty number of cases in which no appreciable improvement could be observed after months of patient waiting. We have seen patients regain their health after the extraction of infected roots or the surgical

treatment of their apices; we have also seen patients from whose mouths as many as ten teeth have been extracted in the hope of eliminating a deep-seated infection with no other result than the loss of their masticatory organs.

We believe that to a large extent these negative results can be traced to a misconception of the pathologic significance of certain shadows in radiographic films or plates and to the unwarranted advice so liberally dispensed that tooth roots presenting what is erroneously interpreted as an active focus of infection should be at once sacrificed to the forceps. Clinical results are flatly contradicting the assumption that every shadow upon the root of a tooth in a radiograph is a focus of infection, and laboratory experiments in those same cases are likewise giving negative results. A shadow on the apex of a root may indicate one of several things, herein including the filling up of the cancellated spaces in the alveolar bone by a proliferation of the soft tissue which normally fills the cancellated spaces. If as the result of an involvement of the alveolar bone, following an infection emanating from the pulp or pericemental membrane, some of the cancellated spaces are destroyed, as occurs in osteomyelitis, following, or simultaneous with, an inflammatory proliferation of the myelitic substance (the substance contained in the cancellated spaces), a dark shadow will be brought out upon the radiograph even though all bacterial elements be absent, i. e., the density of the area has been materially decreased by the filling in of the enlarged cancellated spaces by soft tissues. Again, in the case of a chronic infection of the peridental membrane which has spread to the alveolar process, causing the loss of osseous substance with perhaps practically no attempt at obliteration of the space by organic tissue, a dark shadow will be shown on the plate even after complete eradication of the infection.

Another misconception of root pathology is in the tendency to regard dark shadows upon radiographs as evidence of the presence of granulomata; viz., tumors or enlargements of the peridental membrane made up of a large number of embryonic connective tissues containing within its meshes epithelial elements or again made up entirely of connective tissue. The number of teeth which we have examined after extraction which upon previous radiographic examination showed fairly large blackened areas adjacent to the apical region, leads us to the conclusion that the presence of granulomata is the exception rather than the rule.

A "Stop—Look—Listen" sign is appearing in the dental horizon and the leaden forceps of the Temple of Apollo at Delphi is again casting its shadow. Valuable as unquestionably the x-ray has become in the hands of the radiographer-pathologist, equally as dangerous it is becoming in the absence of a complete system of diagnosis which should include the history of the case; the clinical examination, laboratory findings and the x-ray. Complete reliance on the radiograph is, at the present time at least, not warranted as the sole means of diagnosis. *It is not the x-ray machine alone that the dental office needs; as much as it does the x-ray machine plus correct pathologic interpretation of lesions of the teeth and adjacent structures.—Editorial by Julio Endelman, in the "Pacific Dental Gazette."*

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EDITORIALS

Dentists in the Army

AS the United States is preparing to do its part in the great world conflict in order that democratic government may exist, and that principle founded upon personal freedom will not be brushed aside by military rule, we are confronted with the problem as to what is the duty of the dentist in the present world conflict.

About a year ago there was organized the Preparedness League of American Dentists, the object of which was, that each member of the league should prepare the mouth of one recruit in such a manner that he would be able to perform military service. A large number of men joined the Preparedness League of American Dentists because the initiation fee was only one dollar, and they considered such a move a patriotic measure regardless of whether they were called upon to do anything or not. Up to the present time, a large per-

centage of that membership have performed their service by preparing the mouth of one recruit in such a manner so that he can pass military examination, but there are also a large number who have not done anything.

It is hoped that every man in the dental profession will do his part in preparing the teeth of one recruit in such a manner that he will be able to serve his country. It is not expected that every dentist will be able to perform military service, because there are a large number of men who are better fitted for that purpose than the dental profession. However, it must be remembered that a number of dentists will be required in the army, and the number required will be much larger than that provided for by army regulations.

At the present time, one dentist is allotted to about every one thousand soldiers. Everyone knows that in time of peace it is impossible for one dentist to keep one thousand mouths in order, giving them the proper dental and prophylactic treatment which they should receive. It is a fact that there has been provided a Reserve Dental Corps to which dentists can be admitted by passing a physical and professional examination before a board composed of two army dental men and one medical man, proving their fitness for this service. They are then appointed for five years subject to call upon invasion or threatened invasion of the country by an enemy or upon a declaration of war.

The men of the Reserve Dental Corps have the rank of first lieutenant with a salary of $2,000 a year when in service. They are allowed all of the allotments going with their rank while engaged in service; and if injured in service, receive the same pensions as other men of their rank. We are informed that there are a large number of men who have applied for admission to the Reserve Dental Corps which is as it should be. We have also been informed of the large number who have applied for admission into the Reserve Corps, some have attempted to get a rank higher than lieutenant, and we have been informed that even some have made applications for the rank of major without having had any previous military service. Of course, such things in the eyes of military men make the dental profession appear ridiculous, and it is hoped that those who enter the Dental Reserve Corps will remember that there are a great many men who are better fitted for military service than is the dentist.

In other words, the dentist has a very important service to perform, but he should be satisfied in performing that service. We have also learned that a large number of men who were applying for admission to the Dental Reserve Corps hope or are of the opinion that they will be allowed or permitted to do a large amount of oral surgery and not be called upon to perform ordinary dental operations. As a matter of fact, the men which the army and navy need today are men who will do ordinary dental work and prepare the mouths of army and navy recruits in such a manner that they will be able to perform the proper military service.

There is a large amount of "preparedness" work needed which can be performed by dentists, and someone must do the ordinary dental work. Every dentist who enters the Dental Reserve Corps should not expect to do oral surgery because it is our hope that there will be very little demand for oral surgery which always comes after the conflict. The dentist's work is necessarily one of

preparedness, and must be rendered before the actual army and navy engagements take place. Of course, upon the field of battle, in the line hospitals and base hospitals, someone will have to do oral surgery, and at that time it is very probable that the dentist with the first contingent will be the one who will get the major amount of oral surgery.

However, it must be remembered that the work of the oral surgeon will be comparatively small compared to the work of the general dentist, and we are therefore making the plea in the name of patriotism that the dental profession do their part as dentists because they will have as important a part in winning this battle by doing their work well along dental lines and oral prophylactic lines, as will any other group of men. We believe, therefore, that the dentists who enter the army and navy should be dentists first, and oral surgeons afterwards.

In regard to official rating and standing in the army and navy, if they are qualified, do their work well, perform the tasks which are before them today, tomorrow, and the next day, the best they possibly can, there is no question but that they will be in line for promotion as well as any other branch of men. It must be remembered in raising a large army and navy, as the nation hopes to do, each group of men will be compelled to do the work allotted to it. We hope the dental profession will not make itself appear ridiculous by trying to assume responsibilities or do a line of work which is entirely beyond it, and not be content to do that which it is supposed and qualified to do. The importance of the dentist in the army can not be overestimated, but fulfilling that importance rests with the dentist first, last, and always.

We have observed in our conversations with various men who are contemplating joining the Dental Reserve Corps that they seem to be ashamed to admit that they are dentists, and all of them are trying to become oral surgeons. The man who is not ashamed to fight for his country and his flag should also not be ashamed of his profession, and especially when the profession is one of the most important and one of the most useful in the army and navy today.

The National Dental Journal and the State Dental Journals

AT various times we have mentioned the fact that the crying need of the dental profession is independent journalism, or journals which are not controlled by dental supply houses, which are published for the advancement of dental science from a scientific standpoint, and not for the advancement of the sale of commercial articles.

If there is any one thing that the dental profession needs more than any other to advance it and to bring it up to the standard which it should occupy, to give it the dignity of a profession which we have always hoped it would have, it is the establishment of independent dental journals. The foundation of the *Journal of the National Dental Association* was a step in the right direction, and our only regret is that it has received so little recognition and support from the dental profession. We wonder if a greater effort could not be put forth, and greater good accomplished, if there would be united efforts towards the foundation and support of independent dental journalism. With the reorganization of

the National Dental Association the various state societies were made component parts of the Association in order that it would have a larger membership so it would be possible with the state membership to establish and maintain a national dental journal.

Now that most of the dental societies have been made component parts of the National Dental Association, we believe that each state society should work with the one single purpose of advancing the Association and consequently advancing the *Journal of the National Dental Association.* We find that the various state dental societies have adopted different methods in the publication of their proceedings. A number of the state societies still follow the plan of having their proceedings published by some trade journal, while a few state societies publish their proceedings in a monthly journal, and others have the same published in bulletins. We believe that the publication in state dental journals, whether published monthly or in the nature of a bulletin which contains only the proceedings of the society, is a step in the right direction. But we also believe that at the present time greater good might be accomplished, the National Dental Association be made a stronger organization, and its journal be made a more powerful organ, if each state association would lend its support to the Journal.

For instance, in some states in addition to the dues which are paid to the state society and into the National Dental Association, there is a certain proportion of the dues which goes to the support of the state journal or the bulletin. If the amount of money which is paid by the state societies for the publication of state dental journals and state bulletins were turned over to the *Journal of the National Dental Association,* and the proceedings of the state societies published in this Journal, the papers from the state dental societies would have a wider circulation, and the Journal would be a more powerful organ. If the state societies are component parts of the National Dental Association, why should they not be component parts in fact as well as name? Why should not the proceedings of state dental societies be published as a part of the Journal, and this Journal be published monthly, or better, every week, as the *Journal of the American Medical Association* is published?

If there is not sufficient money in the treasury of the National Dental Association to make its journal the official organ of all the component state societies, then some provision should be made for raising more money for its supprt. In the case of states that have special journal funds, or societies which contribute a certain amount for the publication of their proceedings in an independent dental journal, this sum of money can be diverted to the *Journal of the National Dental Association* which can publish the proceedings of those societies even if it can not publish the proceedings of all the other states. If it were possible for some few states to make the move towards contributing a sum of money to the journal or to publish their proceedings in National Journal, it would only be a short time until the various other state societies would follow the lead and the National Dental Journal would be a national journal in fact as well as in name.

One objection which has been raised to the publication of independent dental journals, state journals, or state bulletins is the fact that the proceedings of those societies are not given a wide circulation, and papers which are valuable are

very soon lost or are brought to the attention of only a few readers. Therefore, if all of the state societies would publish their papers in the Journal they would all have an equally wide circulation, they would all be in a compact form which could very easily be preserved and papers which are worth something would be a matter of record.

We do not forget the fact that a great many papers which are read before state dental societies are simply a repetition of something that has been worked out before. It would therefore be necessary for the journal to be presided over by an editor who had sufficient knowledge of dental literature, and sufficient knowledge of important subjects, to enable him to edit the articles from the state dental societies and eliminate such as were not worthy of publication. This would alleviate the necessity of publishing matter over and over again, which would result unless the editor of the journal had sufficient authority to edit the proceedings of the various state societies.

We believe, then, that the greatest good can be accomplished by the *Journal of the National Dental Association* being made a national dental journal in fact as well as name, and that this can be best accomplished by the united efforts of all the component societies working for the support of the journal and deverting such money as they now devote to the publication of state journals, bulletins, or trade journals for the publication of their proceedings, into the treasury of the *Journal of the National Dental Association* and so make the Journal a more powerful organ. The Journal should be presided over by an editor-in-chief, whose sole purpose should be the editing of the Journal, or by an editorial board which will have sufficient authority to edit all the articles that come for publication so that there will be published only articles that have real merit. Other articles, which are simply a repetition of the subject, will not be published, and if this plan is followed out, we will find that the National Dental Association and the dental profession as a whole will have a journal of which they will be proud.

The Pathmaker in Dentistry and Medicine

"I will not follow where the path may lead, but I will go where there is no path, and I will leave a trail."

—Strode.

THE great need of the dental and the medical professions today is the pathmaker; the man who will walk through the untrodden field and leave a trail. Original thinking and doing is hard work, and man inherently is a lazy animal. Most men prefer to loiter along the beaten highway, content to pick here and there a berry or a flower that has been overlooked by the travelers who have passed on before, rather than take chart and compass, explore the trackless wild, make a new path, derive all the pleasure and profit that belongs to the pioneer, and leave a trail.

Fill a root canal like a thousand others have been filled, crown or inlay just as your predecessor has done countless times before you, correct a de-

formity just as your textbooks tell you, classify a pathological condition just as someone else classified it for you, and go on your way content to eat, sleep, and reproduce your kind. Moles have no need for eyes because they live in eternal darkness. Many professional men, so far as seeing things and adding to the sum total of human knowledge is concerned, are closely akin to the mole.

The curse of civilization is the man with rules. He learns a rule for some special phase of technic from a teacher or a textbook, and he follows that rule to his professional grave. Afraid to break away from precedent, he follows like a beast to the shambles. It seems to be a difficult matter for dentists and physicians to realize that every case that comes under their care is one that presents problems differing from that of other individuals and calling for thought and careful observation. Teeth have been filled for generations, and the operator has prided himself that they have been correctly filled, until the x-ray revealed that the work was that of a bungler. Crowns have been put on that appeared to be well done. The technic adopted was the same that the textbook or the instructor advised, but in a short time the patient upon whom the rule of thumb was practiced developed an arthritis, a neuritis, or an endocarditis. By good chance the patient falls this time into the hands of a man who does a little thinking on his own account. His textbook may never have told him that teeth could be badly crowned. His instructor may never have brought to his attention the fact that tooth infection can be the cause of systemic disease; but, because this man has been trained to think, because this man follows no path but makes his own and leaves a trail, he goes over his patient from head to toe. He sees the evidence of focal infection, and as a result of his efforts the mistakes of the man who crowned the tooth strictly according to the textbook, are brought to light.

Much of this dearth of original thinking on the part of the dentist can be laid squarely at the doors of the dental college and the dental journal. Few teachers in dental schools have as their chief objective the implantation of suggestion in the minds of their students that will aid the students to think for themselves. In this there is another evidence of the blind trying to lead the blind. Most teachers in dental schools live by rule, work by rule, and teach by rule. One of the sad features connected with dental education today is the fact that so many teachers have nothing more than a grammar school education. Their vision is restricted to the mechanical side of their work, and their sole ambition seems to be to educate dentists that may be good mechanics, but very poor scientists, and with no power of original thought. Much of the blame for the dearth of original thinking and path-finding among the dentists can be laid justly to the dental journals. Controlled by the manufacturer and the jobber in dental supplies, the journals of this country have done little or nothing to stimulate research work and individuality of thought among the dentists. Human action, without exception, is dominated and controlled by stimulation. Unless you stimulate there is no life. A scientific journal exists by right of its ability to stimulate scientific thought and to widely disseminate information. When it fails to do this, it has forfeited its right to exist. A scientific journal can do more to stimulate original work among its readers through its editorial pages than in any other way, but the dental journals of America seem to be

unmindful of this obligation. Go through the file of any of them for five or ten years back, and you will see little that would stimulate a dentist to make his own path in his science and leave a trail.

But let it be said that at the present time a change from the old order of things is in evidence. Dental schools are awakening; the unfit among them are doomed, and, like the aborigines, will soon live only in memory and in song. Universities with trained, educated teachers will take their places, and these will give birth to a race of dentists that will be an honor to the science of dentistry, and a blessing to mankind; and the dental journals, too, will evolute, and the unfit will join the discarded colleges upon the scrap heap. Independent journals will take the place of the trade controlled and commercially dominated organs that now circulate widely through the graces of pound postage rates. Then the worker in dentistry will follow no path; each will make his own path, and will leave a trail.

Program of the Seventeenth Annual Meeting of the American Society of Orthodontists

Elms Hotel, Excelsior Springs, Mo., September 5 to 8, 1917

I. President's Address, Dr. M. N. Federspiel, Milwaukee; Report of the Board of Censors.

II. Anatomy and Physiology.—(1) The Evolution of the Human Teeth, Prof. H. F. Osborn, New York City.

III. Medicine and Therapeutics.—(1) Constitutional Diseases in Infancy and Dentition, Dr. Gustav Lippmann, St. Louis; (2) The Oral Efficiency of Therapeutic Preparations, Prof. Hermann Prinz, Philadelphia; (3) The Scientific Feeding of Growing Children, Mr. A. W. McCann, New York City.

IV. Surgery.—(1) The Surgical Treatment of Extreme Malformations Involving the Jaws, Tongue, etc., Dr. Gordon New, Rochester, Minn.

V. Radiography and Photography.—(1) Practical Radiography for the Orthodontist, Dr. E. H. Skinner, Kansas City; (2) Orthophotography and Multiview Projections, Mr. Rudolph L. Hanau, Brooklyn.

VI. Etiology, Pathology, and Prognosis.—(1) A Further Study of Prenatal Causes of Dento-facial Deformities, Dr. B. W. Weinberger, New York City.

VII. Practice and Technology.—(1) Subject to be announced, Dr. Calvin S. Case, Chicago; (2) Further Experiences with my Appliances for the Correction of Dento-facial Deformities, Dr. Ray D. Robinson, Los Angeles; (3) A Skeleton Bite-plane for Establishing a Normal Overbite, Dr. J. Lowe Young, New York City; (4) The Indirect Method of Anchor-band Construction, Dr. Martin Dewey, Chicago.

VIII. Legislation, Education, and Nomenclature.—(1) Report of the Committee on Education; (2) Report of the Committee on Nomenclature.

IX. Clinics.—A large number have already been secured, to be announced later.

X. Exhibits.—Manufacturers and publishers of books, periodicals, x-ray and photographic equipments, orthodontic appliances and supplies, have been invited to exhibit during the meeting.

Mouth Sepsis

Considerable attention has been bestowed on oral sepsis as an essential etiologic factor in systemic infections, and there is reliable scientific evidence in support of the tooth-root theory of this large class of diseases. The fact that chronic septic foci in teeth and elsewhere are exceedingly difficult to recognize in the majority of cases is undoubted. It is particularly instances of periapical infection or abscess that offer the greatest difficulty in this respect. Here, even a roentgen examination, which should always be made by an expert, may fail to render reliable aid.

Deland states that the diagnosis of mouth sepsis should be made by a dentist who is specially trained for this, in which opinion I concur. The physician, however, who encounters a case of systemic infection in which the teeth are suspected should refer the patient to a competent nose and throat specialist with a view to eliminating all foci other than those which may be present in the mouth before invoking the services of the specially trained dentist. It sometimes happens that multiple foci are discoverable, in as many different organs, as the teeth, tonsils and sinuses.

Successful treatment of secondary systemic infection demands, first and foremost, the removal of the septic focus or foci on which they depend. Before reducing the masticating surface of a particular patient, however, the evidences of an existing necessity for so doing should be as clear and convincing as possible. An attempt by a competent dentist should be made to heal the morbid lesions in and about the tooth roots, since some of these are amenable to expert management, before ordering the extraction of the teeth.

Within the past six months a number of dentists have informed me that countless teeth are being removed without justification, on the advice of physicians, usually following a roentgen examination (by amateurs in many instances). In well authenticated cases in which one or two teeth were the seat of peripheral infection, physicians have gone so far as to give emphatic directions to the effect that all of the remaining teeth be extracted. For example, one of Philadelphia's best known specialists in extraction was requested by a physician to pull out all of a certain patient's teeth—twenty—but he courteously, though firmly, declined to do so.

It seems to me that the rapidly growing custom of sacrificing teeth, many of which are merely suspected of being septic, can not fail to arouse the most ardent activity of dentists in opposition thereto, and must prove the ultimate chagrin of the medical profession. It would appear that an amazingly low estimate is being placed on the value of human teeth by an increasing number of physicians, who should appreciate the importance of a good masticating apparatus to the digestive function—to the maintenance of health.

I do not mean to disparage the significance of these latent chronic septic foci as a cause of secondary systemic infections or to depreciate investigations in this, comparatively speaking, new field of endeavor. The object of this letter is to utter a word of warning with a view to lessening what I believe to be an unwarrantable present-day sacrifice of the masticating surface, and to spare the medical profession the adverse criticism of the future, by a broader conception proper to the subject of oral sepsis and its management in the present.—*J. M. Anders, M.D., Philadelphia, Journal of the American Medical Assn.*